كلية التجارة

Faculty of Commerce - Cairo University

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Introduction To Computers & Accounting Applications

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بسم الله الرحمن الرحيم

**وَلَوْ بَسَطَ اللَّهُ الرِّزْقَ لِعِبَادِهِ لَبَغَوْا فِي
الْأَرْضِ وَلَكِن يُنَزِّلُ بِقَدَرٍ مَا يَشَاءُ إِنَّهُ
بِعِبَادِهِ خَبِيرٌ بَصِيرٌ**

سورة الشورى (٢٧)

إهـــــداء

الى روح والدى العظيم
اسكنه اللّه فسيح جناتــه

PREFA

Most businesses, large or small turn to the computer to process business transactions and to analyze business problems. Understanding the computer-how it works and how it can be used is becoming more essential to be productive and successful in today's work.

This book presents fundamental concepts in a manner that emphasizes their importance from the user's point of view. No previous experience with computers is required for this book.

This book is divided into ten chapters, Chapter (1) provides an overview on computer systems and their evaluation. Chapter (2) describes the various input devices commonly used by computer users. Chapter (3) focuses on the brain of the computer. Chapter (4) explains how data is being represented in the central processing unit secondary storage media and devices are described in. Chapter (5) provides a brief review of

the various output devices of a computer system. Chapter (6) presents a detailed discussion of processing data into information. Chapter (7) discusses Networking and computer connections. Chapter (8) introduces an in depth discussion of the computer software, the operating system. Chapter (9) provides an introduction to program development stages. Finally Chapter (10) Provides An Idea About Spreadsheets And business graphics.

Overall I hope this book will be judged as a significant new contribution to the teaching and learning of computer essentials and accounting applications.

Dr. Medhat Abd El-Rasheed

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2016

Chapter (1) AN INTRODUCTION TO COMPUTERS

LEARNING OBJECTIVES :

* **Know the basic components of a computer system.**
* **Be able to distinguish data from information.**
* **Become familiar with the various classifications of computers.**
* **Know the characteristics of a computer.**
* **Understand the categories of software.**

This introductory chapter is a quick tour through the fundamentals of the computer. Our objective is to provide an overview of the concepts involved and terms and definitions used to set the scene for the rest of the book.

1.1.WHAT IS A COMPUTER ?

A computer is a machine that can be programmed to accept data (input), process it into useful information (output), and store it away (in a secondary storage device) for safekeeping or later reuse. The processing of input to output is directed by the software but performed by the hardware.

Figure (1) shows a general block diagram of a computer. There is some input to the computer and it gives some output. Input to the computer is usually data and output from the computer is the resulting information. It is important to

understand the distinction between data and information.

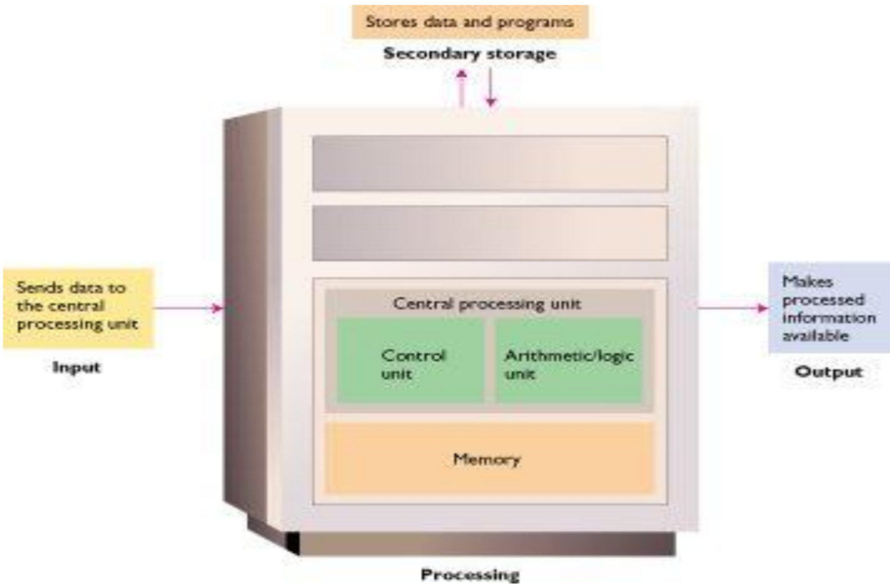
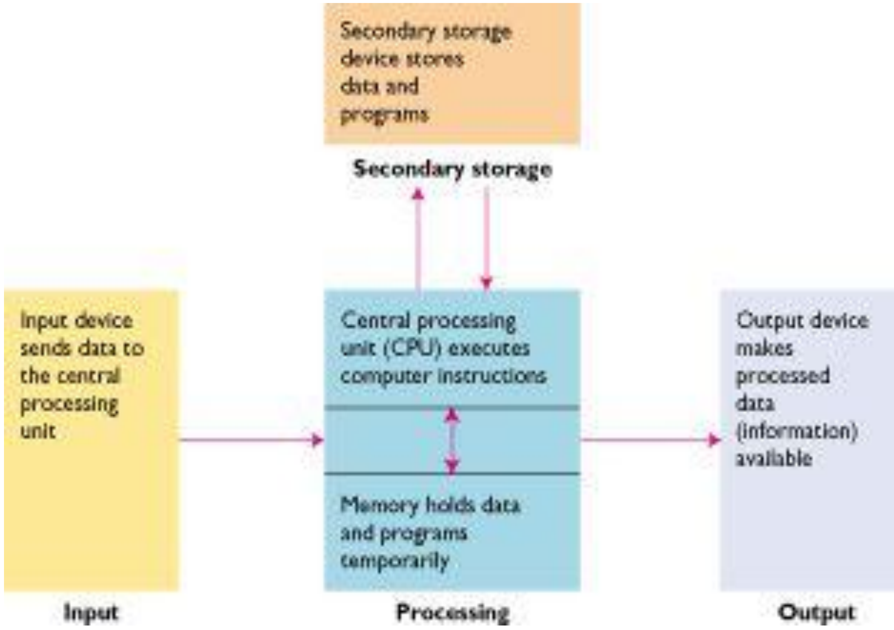


FIGURE (1) A block diagram of the computer

To function, a computer system requires four main aspects of data handling: input, output, processing, and storage (Figure 2). The hardware responsible for these four areas is as follows:

- ***<u>Input devices</u>*** accept data or commands in a form that the computer can use; they send the data or commands to the processing unit.

- ***Processor***, more formally known as the central processing unit (CPU), has electronic circuitry that manipulates input data into the information people want. The central processing unit actually executes computer instructions.
- ***Output devices*** show people the processed data--information--in understandable and usable form.
- ***Storage*** usually means secondary storage, which consists of secondary storage devices such as disk--hard disk or diskettes or some other kind of disk--that can store data and programs outside the computer itself. These devices supplement memory or primary storage, which can hold data and programs only temporarily.



(Figure 2).

1.2. DATA VERSUS INFORMATION :

Simply, data is the origin of information. The data is the raw material from which information is derived. Data is a representation of facts, concepts, suitable for communication, interpretation, or processing by humans or computers. Examples of data are: The name of a person, the date of an event, the serial part

number of a product, the score of a student, ect., if considered on its own, an item of data has very little value.

Data must be processed in a given way to give information. That is, information is the meaning assigned to data by humans. The processing of data to give meaningful information involve one or more operations and can be carried out by humans either manually or by using data processing equipments, such as a computer.

Therefore, information is comprised of data that have been collected and processed into a meaningful form. We normally use data to produce information that will help us making decisions.

1.3. THE COMPUTER SYSTEM :

A computer system is a combination of six elements:

1- Hard ware.

2- Software.

3- Data - information

4- Procedures.

5- People.

6- Communications.

1.3.1. Computer Hardware:

The computer hardware is the physical equipment you see and touch when using a computer system. It consists of a number of individual components, each of which has its own function.

****Input Hardware:*** The function of input hardware is to collect data and convert it into a form suitable for computer processing. The most common input devices are the keyboard and the mouse.

****Processing Hardware:*** Processing hardware is the brain of the computer, where all computations, decisions and control is carried out. The processing Unit is commonly called central Processing Unit (***<u>CPU</u>***).

****Storage Hardware:*** Storage hard ware is used to hold the program that controls the function of the computer, along with the required data to be processed. There are two main types of memory, ***<u>main memory</u>*** or *<u>internal memory</u>*, and ***<u>auxiliary memory</u>*** or *<u>external storage</u>*. The first type is closely associated with the C.P.U but separate from it. The most common auxiliary storage is magnetic disk and magnetic tape.

****Output Hardware:*** Output hardware is a device connected to the computer to deliver information for human use. The most common output devices are the printer and the monitor.

Communications Hardware: The function of communications hardware is to facilitate the connections between computers and groups of connected computers (Networks). An example of communications hardware is the ***MODEM*** which allows computers to be communicated with each other over telephone lines. Figure (3) shows the components of hardware.

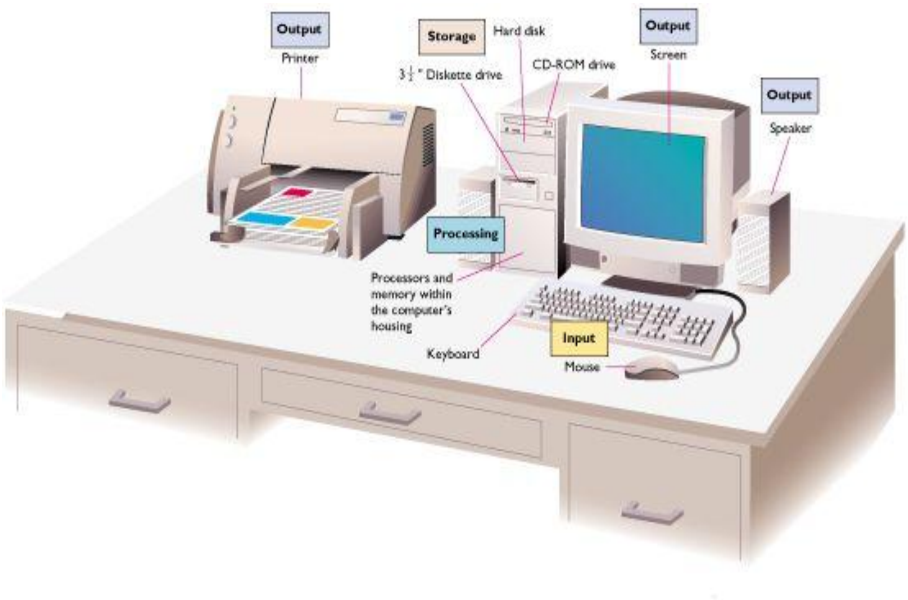


Figure (3) ***Components of hard ware***

1.3.2. Computer Software:

Actually, without software the computer system is off on use. The software is the intangible control that governs the computer operation. Software is a general term for all of the computer programs that are involved in the operation of the computer system. You cannot touch software, but it can be stored in, and retrieved from memory. Generally speaking, software can be categorized as ***system software and applications software***.

System software consists of programs supplied by the computer system manufacturer to help the user of the system and to control the operation of the computer system. At the core of the system software are the operating system and the tools used to write new programs. Other types of system software are compilers, assemblers and

interpreters. ***Applications software*** consists of the programs to do the various jobs the computer was purchased to do in the first place. Programs that make up pay rolls, play games, solve mathematical equations, design electronic component or compute the orbits of spacecraft are examples of applications software. Applications software can be either written by the computer user (if he knows how to write computer programs), or purchased ready-made from specialized software suppliers. The most popular activities carried out on smaller type or microcomputers are: games, graphics, word processing, spread sheets, data base management and business.

1.3.3. Data - Information:

We discussed this point (data and information) in a previous section No. 1.2.

1.3.4. Procedures:

Procedures are descriptions of how things are done, steps for accomplishing a result. Procedures for computer systems appear in documentation manuals, also known as reference manual which contain instructions, rules and guidelines to follow when using hardware and software.

1.3.5. People:

People constitute the most important component of the computer system. People may include:

- **Data entry personnel** to prepare and enter data into computer.
- **computer operators** to run the computer
- **Programmers** to write specialized programs.
- **System analysts** to design the software applications.

- **A data base administrator** to control and manage data and management to oversee the use of the computer
- **Users** are those people either directly use computer or who benefit from the output of the computer processing.

1.3.6. Communications:

When one computer system is set up to share data and information electronically with another computer system, communications becomes a sixth system element. For example, wires, cables, phone lines, microwave transmission, or satellite is an element of the total computer system.

1.4. COMPUTER CLASSIFICATIONS :

Computers can be classified from three points of views: size, electronic calculation, and purpose,

1.4.1. Computer Classifications from the Size View Point:

The most distinguishing characteristic of any computer system is its size not its physical size, but its computing capacity. Computers are generally classified according to their size, speed, processing capabilities, and price. The four major categories of computers are ***micro computers***, ***minicomputers***, ***mainframe computers***, and ***supercomputers***.

1.4.1.1. Microcomputers:

Most often called personal computers, or just P.C. These desktop computers are also known as microcomputers, or sometimes home computers. This category includes laptop, portable, and super micro computers.

1.4.1.2. Minicomputers:

Minicomputers are more powerful than microcomputer and can support a number of users performing different tasks. We describe the minicomputers simply as the smallest computer designed specifically for the multi-user environment (10 to 40 employees). Minicomputers are also common in research groups, engineering firms, and colleges.

1.4.1.3. Mainframe Computers:

Mainframe computers, the computer category between minicomputers and supercomputers, are also called ***maxi-computers***. Mainframe computers are large systems that can handle numerous users, store large amounts of data, and process transactions at a very high rate. Mainframes usually require a specialized environment

including separate air conditioning and electrical power.

1.4.1.4. Supercomputers:

Supercomputers are most powerful category of computers. Supercomputers handles the types of computer applications that are helpful to engineers and scientists. Super computers are more likely to be configured with sophisticated graphics workstations and plotters than with high-speed printers

supercomputer

SOURCE: Ace Stock Limited/Alamy.

Figure 2.11
A Mainframe Computer
Mainframe computers have been the workhorses of corporate computing for more than 50 years. They can support hundreds of users simultaneously and handle all of the core functions of a corporation.

Mainframe

Personal computers

1.4.2. Computer Classifications from Electronic Calculation View Point:

Form this point of view, computers are classified into:

1.4.2.1. ***Analog Computers***:

Analog computers measure continuous physical or electronically magnitudes such as pressure, temperature voltage. They are used

basically in scientific applications, and give only approximate results.

1.4.2.2. ***Digital Computers***:

Digital computers can operate numbers and achieve varying degrees of accuracy, depending on their particular construction and machine characteristics. Such computers are used for both scientific and business applications.

1.4.2.3. ***Hybrid Computers***:

Hybrid computers contain both analog and digital components. Because of this characteristic they are suitable for all types of processing operations.

1.4.3. Computer Classifications from the Purpose View Point:

From this view point computers are classified into:

1.4.3.1. ***Special - Purpose Computers***:

Special - purpose computers are designed to perform a specific processing task. The program of instructions is built into the machine.

1.4.3.2. ***General - Purpose Computers***:

General purpose computers can be used for a variety of jobs or applications. They are particularly suited for business purpose because of the variety of data processing tasks. For example, a general purpose computer can be used for a payroll, application, followed immediately by an inventory application and so on.

1.5. CHARACTERISTICS OF A COMPUTER :

Computers are fast, accurate, reliable, have enormous memory capacity, can perform arithmetic and logical operations, and can execute stored program.

Speed*:**. This characteristic is essential to the speed of computers. The smallest unit of time in the human experience is the ***second. Computer operations are measured in ***milliseconds*** (one thousandth of a second), ***microseconds*** (one millionth of a second), ***nanoseconds*** (one billionth of a second), and ***picoseconds*** (one trillionth of second).

****Accuracy*:** Errors do occur in computer systems, but few can be directly attributed to the computer system itself. The vast majority of the errors can be traced to a program logic error, a procedural error, or erroneous data. These are human errors.

****Reliability*:** Computer systems do not take sick days and coffee breaks, and they seldom complain.

*** *Memory Capability and Retrieval of Data*:**

Computer system have vast capabilities for

storage and retrieval of data. A typical mainframe computer system will have many billions of characters stored and available for instant retrieval.

*** *<u>Performing Arithmetic and Logical Operations</u>:*** A computer is able to perform ***<u>arithmetic operations</u>*** such as ***addition***, ***subtraction***, ***multiplication***, and ***division***. In addition a computer is able to compare one piece of information with another to determine whether they are ***equal***, or whether one of them ***is less*** or ***greater than*** the other. Such comparison operations are called ***<u>logical operation.</u>***

*** *<u>Executions of Stored Programs</u>:***

A computer internally stored the program instructions. It can execute such instruction for operation to be performed on data.

1.6. COMPUTERS DEVELOPMENT :

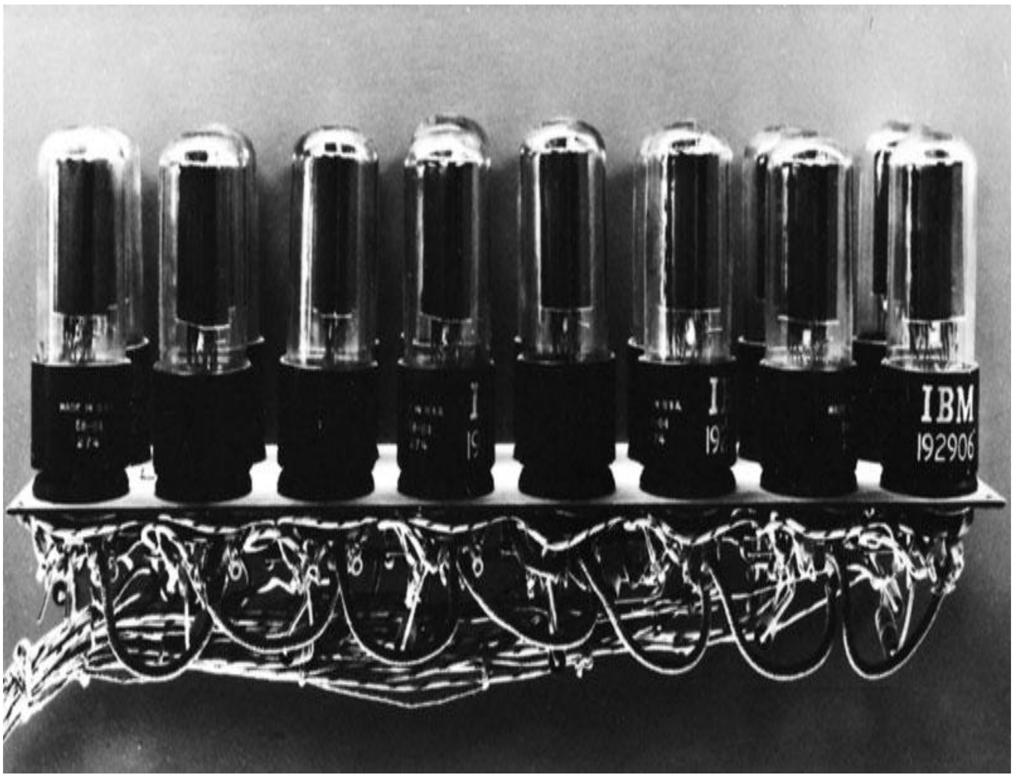
It is of interest to highlight that electronic computers have developed through five major generations.

1.6.1. The First Generation (1951- 1958): The Vacuum Tube:

The beginning of the commercial age may be dated June 14, 1951. This was the date the UNIVAC—Universal Automatic Computer—was delivered to a client, the U.S. Bureau of the Census, for use in tabulating the previous year's census. The date also marked the first time that a computer had been built for business applications rather than for military, scientific, or engineering use.

In the first generation, ***vacuum tubes*** electronic tubes about the size of light bulbs were used as the internal computer components.

However, because thousands of such tubes were required, they generated a great deal of heat, causing many problems in temperature regulation and climate control.



1.6.2. The Second Generation (1959- 1964): The Transistor:

Three Bell Lab scientists J. Bardeen, H.W. Brattain, and W. Shockley developed the transistor, a small device that transfers electric signals across a ***resistor***. (The name transistor began as a trademark concocted from ***transfer plus resistor***). Transistors were much smaller than vacuum tubes, and they had numerous other advantages: They needed no warm-up time, consumed less energy, and were faster and reliable.

1.6.3. The Third Generation (The Integrated Circuit) (1965-1970):

An integrated circuit ***(IC)*** is a complete electronic circuit on a small chip of ***silicon***. The chip may be less than **1**/**8** inch square and contain thousands or millions of electronic components.

In 1965 integrated circuits began to replace transistors in computers. The resulting machines were called third generation computers. An integrated circuit was able to replace an entire circuit board of transistors with one chip of silicon much smaller than one transistor. Integrated circuits are made of silicon because it is a ***semiconductor***.

Software became more sophisticated during this third generation. Several programs could run in the same time frame, sharing computer resources. This approach improved the efficiency of computer systems. Software systems were developed to support interactive processing, which used a terminal to put the user in direct contact with the computer. This kind of access caused the customer service industry to flourish, especially in areas such as reservations and credit

checks. Large third-generation computers began to supplement by minicomputers, which are functionally equivalent to full-size systems but are somewhat slower, smaller, and less expensive. These computers have become a huge success with medium-size and smaller businesses.

1.6.4. The Fourth Generation 1971—Present: The Microprocessor:

Through the 1970s computer gained dramatically in speed, reliability, and storages capacity, but entry into the fourth generation was evolutionary rather than revolutionary. The fourth generation was, in fact, an extension of third-generation technology. That is in the early third generation, specialized chips were developed for computer memory and logic. Thus, all the ingredients were in place for the next

technological development the general-purpose processor-on-a-chip, otherwise known as the ***microprocessor***, which became commercially available in 1971.In addition to the common applications of digital watches, pocket calculators, and personal computers, you can expect to find microprocessors in virtually every machine in the home or business—cars, copy machines, television sets, bread-making machines, and so on. Computers today are 100 times smaller than those of the first generation, and a single chip is far more powerful than ***ENIAC*** Electrical Numerical Integrator and Calculator)

1.6.5. Fifth Generation Computers (1984--1990)

Fifth generation computers are in developmental stage which is based on the ***parallel processing hardware*** and ***the artificial intelligence software*** . The goal of the fifth generation is to develop the device which could respond to ***natural language*** input and are capable of learning and self-organization. So we can say that the fifth generation computers will have the power of ***human intelligence***. The fifth generation computers will use super large scale integrated chips, and they will be able to recognize image and graphs. Fifth generation computer aims to be able to solve highly complex problem including decision making, and logical reasoning.

1.6.6. Sixth Generation Computers (1990--)

Many of the developments in computer systems since 1990 reflect gradual improvements over established systems, and thus it is hard to claim they represent a transition to a new "generation", but other developments will prove to be significant

changes. One of the most dramatic changes in the sixth generation will be the explosive growth of ***wide area networking***. Network bandwidth has expanded tremendously in the last few years and will continue to improve for the next several years.

	First Generation	***Second Generation***	***Third Generation***	***Forth Generation***	***Fifth Generation***
Size	**Room Size Mainframe**	**Closet Size Mainframe**	**Desk Size Minicomputer**	**Desk top And Laptop**	**Credit Card**
Circuitry	**Vacuum Tubes**	**Transistors**	**Integrated Circuits**	**Semi-Conductor Circuits**	**Super-Conductor Circuit**
Density	**One**	**Hundreds**	**Thousands**	**Hundreds of thousands**	**Million**
Speed Instructions/ Second	**Hundreds**	**Thousands**	**Millions**	**Tens of Millions**	**Billion**
Reliability	**Hours**	**Days**	**Weeks**	**Months**	**Years**
Memory Capacity of Characters	**Thousands**	**Tens of Thousands**	**Hundreds Of thousands**	**Millions**	**Billion**

Table (1) : The five Major generations

Chapter (2)
INPUT TO THE COMPUTER

2.1. What is input ?

2.2. Input devices.

2-2-1- Keyboard devices.

2.2.2. Direct entry input devices.

LEARNING OBJECTIVES :

* **Define the four types of input and how the computer uses each type.**
* **To describe the use and characteristics of the different types of terminals.**
* **Understand how data is input to a computer system, and differentiate among various input equipment.**

Without valid input data, a computer is not capable of producing any useful information. Hence the input step mast occurs before any data can be processed and any information produced.

2.1. WHAT IS INPUT?

Input refers to the process of entering ***programs, commands, user responses, and data*** into main memory. These Four Types of input are used by a computer in the following ways:

****Programs:*** are the set of instructions that direct the computer to perform the necessary operations to process data into information. The program that is loaded and stored in main memory determines the processing that the computer will perform. When a program is first entered into a computer it is input by way of a keyboard. Once the program has been entered and stored on

auxiliary storage, it can be transferred to main memory by a command.

Commands: are key words and phrases that the user inputs to direct the computer to perform certain activities, such as "LOAD”, "RUN"

User responses: refer to the data that a user inputs in response to a question or message from the software. Usually these messages display on a screen and the user responds through a keyboard. One of the most common responses is to answer "YES" or "No" to a question. Based on the answer, the computer program will perform specific actions.

Data: is a raw fact, it is the source from which information is produced. It must be entered and stored in main computer memory for processing to occur. For example, data entered from sales

orders can be processed by a computer program to produce sales reports useful to management. Data is the most common type of input.

2.2. INPUT DEVICES :

Input devices, can be classified for two basic categories

* Keyboard devices.

* Direct entry

As shown in Figure (2.1)

FIGURE (2.1) Input Devices

INPUT DEVICES	
A-Keyboard Devices	***B-Direct Entry***
1.Keyboard ***2. Terminals*** ➢ **Dumb**	***1-Pointing devices*** ➢ **Mouse** ➢ **Trackball** ➢ **joystick**

➢ **Smart** ➢ **Intellige nt**	➢ **Touch screen** ➢ **Light pen** ➢ **Handwritten characters.** ➢ **Digital camera** ***2- Scanning devices*** ➢ **Laser scanners** ➢ **O. M. R.** ➢ **O. C. R.** ➢ **M .I .C. R.** ➢ **Data collection** ➢ **Fax machine** ***3- Smart cards and optical cards.*** ***4- Voice recognition*** ***5- Portable Data entry***

2.2.1. Keyboard Devices:

2.2.1.1. Keyboard:

Keyboards are the most commonly used input devices. Users input data to a computer by pressing the keys on the keyboard. Keyboards are usually separate unit, connected to the computer system with a cable, as in desktop and tower system. A keyboard which usually is similar to a typewriter. Figure (2-2).

FIGURE (2-2) The Key board

Most personal computer keyboards have the following features:

**** Function Keys.*** **** Main Keyboard.***

**** Numeric Keys.*** **** Additional Keys***.

The disadvantage of using a keyboard as an input device is that training is required to use it efficiently.

2.2.1.2. Terminals:

Terminals sometimes called display terminals or Video Display Terminals (VDTs) consist of a keyboard, a display screen, and communications line to a mainframe computer system. Terminals fall into three basic categories: ***Dumb*** terminals, ***Smart*** terminals, and ***Intelligent*** terminals.

2.2.1.2.1. Dumb Terminals:

Dumb terminals are used only for data entry and retrieval. They cannot do any processing on

their own. An example might be a terminal used by an airline reservations clerk.

2.2.1.2.2. Smart Terminals:

Smart terminals can do limited processing as well as data entry and retrieval.

2.2.1.2.3. Intelligent Terminals:

Intelligent terminals are terminals whose processing capabilities are built in. These terminals are also known as programmable terminals because they can be programmed by the user to perform many basic tasks, including both arithmetic and logic operations. Personal computers are frequently used as intelligent terminals.

2.2.2. Direct Entry Input Devices:

Some of the most interesting kinds of input systems don't use a keyboard. Direct entry means

that data is not entered into the computer through a keyboard. Some common direct-entry devices used to input data into computer-usable form are as follows:

1- ***Pointing devices***: mouse, trackball, joystick, touch screen, light pen, digitizing tablet, and handwritten characters.
2- ***Scanning devices***: laser scanners, optical mark recognition, optical character-recognition devices, magnetic ink character recognition, data collection device, and fax machine.
3- ***Smart cards and optical cards***.
4- ***Voice recognition devices***.
5- ***Portable Data entry.***

Because many such devices can't input all types of data and instructions, they are often used along with keyboards.

2.2.2.1. Pointing Devices:

2.2.2.1.1. The Mouse*:*

A mouse is an input device that actually looks a little bit like a mouse. Figure (2.3). The mouse, which has a ball on its underside, is rolled on a flat surface, usually the desk on which the computer sits. The rolling movement causes a corresponding movement on the screen. Moving the mouse allows you to reposition the pointer, or cursor, an indicator on the screen that shows where the next interaction with the computer can take place. The primary advantage of a mouse is that it is easy to use.

Figure 2-3 Mouse.

2.2.2.1.2. Trackball:

A variation on the mouse is the trackball. You may have used a trackball to play a video game. The trackball is like an upside-down mouse you roll the ball directly with your hand. The popularity of the trackball surged with the advent of laptop computers. Trackballs are often built in on portable computers, but they can also be used

as separate input devices with standard desktop computers Figure (2.4).

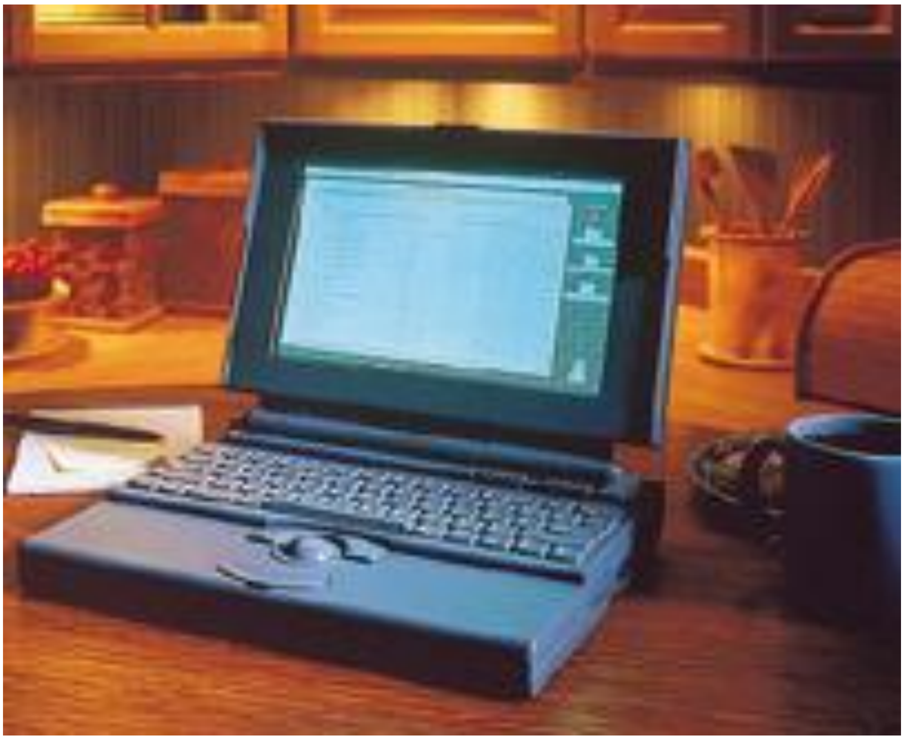


FIGURE (2-4) Trackball

2.2.2.1.3. Joystick:

The joystick is a vertical stick which moves the graphic cursor in a direction the stick is moved. It typically has a button on top that is

used to select the option pointed by the cursor. Joystick is used as an input device primarily used with video games, training simulators and controlling robots.

2.2.2.1.4. **Touch Screens:**

Touch screens allow users to merely touch areas of the screen to enter data. They let the user interact with a computer by the touch of a finger, rather than typing on a keyboard or moving a mouse. It allows the user to operate/make

selections by simply touching the display screen. The user enters data by touching words or numbers or locations identified on the screen. Touch Screens are not used to enter large amounts of data. They are used however for applications in which the user must issue a command to the software to perform a particular task or must choose from a list of options to be performed. They are used in automatic tellers machines ATMs and in directories conveying tourist information in airports and hotels. Figure (2-5)

2.2.2.1.5. Light pen:

The light pen is a light-sensitive stylus. Or pen-like device, connected by a wire to the computer terminal. The user brings the pen to the desired point on the display screen and presses the pen button, which identifies that screen location to the computer. Light pens are used by engineers, graphic designers, and illustrators. Users of Computer Aided Design (CAD) applications commonly use the light pens to Directly draw on screen.

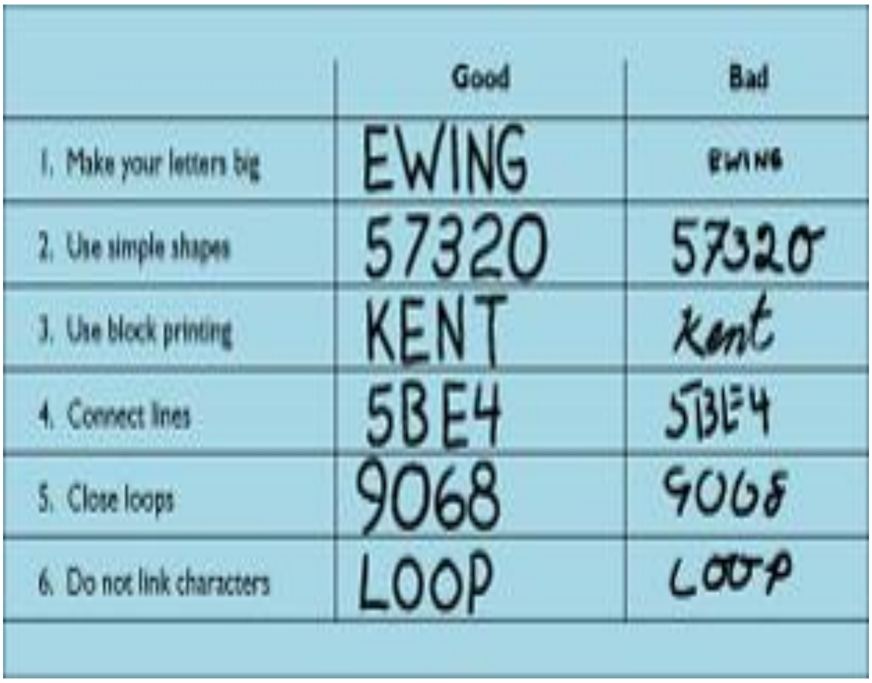
2.2.2.1.6. Digitizing Tablet:

A graphics tablet (or digitizing tablet) consists of a tablet connected by a wire to a stylus. It uses electronics beneath the tablet's surface to register the position of a pointing device. A Digitizer converts points, lines, and

curves to digital impulses and transmits them to a computer. Graphics tablets works in a manner similar to a digitizer, but it also contains unique characters and commands that can automatically generated by the person using the tablet.

2.2.2.1.7. Handwritten Characters:

In many instances it is preferable to write the data and immediately have it usable for processing rather than having data entry operators key it in later. However, not just any kind of handwritten scrawl will do; the rules as to the size, completeness, and legibility of the handwriting are fairly rigid (Figure 2.6.)



	Good	Bad
1. Make your letters big	EWING	EWING
2. Use simple shapes	57320	57320
3. Use block printing	KENT	Kent
4. Connect lines	5BE4	5BE4
5. Close loops	9068	9068
6. Do not link characters	LOOP	LOOP

FIGURE (2-6) Handwritten characters.

2.2.2.1.8 .Digital camera:

A digital camera can store many more pictures than an ordinary camera. Pictures taken using a digital camera are stored inside its memory and can be transferred to a computer by connecting the camera to it. A digital camera takes pictures by converting the light passing through the lens at the front into a digital image.

SOURCE: Istock.

Figure 2.6 A Digital Camera

2.2.2.2. Scanning Devices:

Scanning devices are used to import images of text, drawings, photos, and the like into a computer. They operate by translating images into digital code which the computer can process.

2.2.2.2.1. Bar Codes Reader:

Each product has its own unique number, which is part of the Universal Product Code (UPC). This code number is represented on the product label by a pattern of vertical marks, or

bars, called bar codes. These zebra stripes can be sensed and read by a bar code reader, a photoelectric device that reads the code by means of reflected light. As with the wand reader in a retail store, the bar code reader in a bookstore or grocery store is part of a point of sale terminal Figure (2-7). It is read by a scanner that reads the data and processes it on the system. The first two digits represent the country of origin, the next five represent manufacturer's code, next five represent the product and package size, last digit is a check digit to confirm that the barcode is read correctly, the amount of digits may vary. The barcode does not contain the price. The price is stored in a file that can be accessed by the computer. The computer automatically tells the point of sale terminal what the price is; a printer

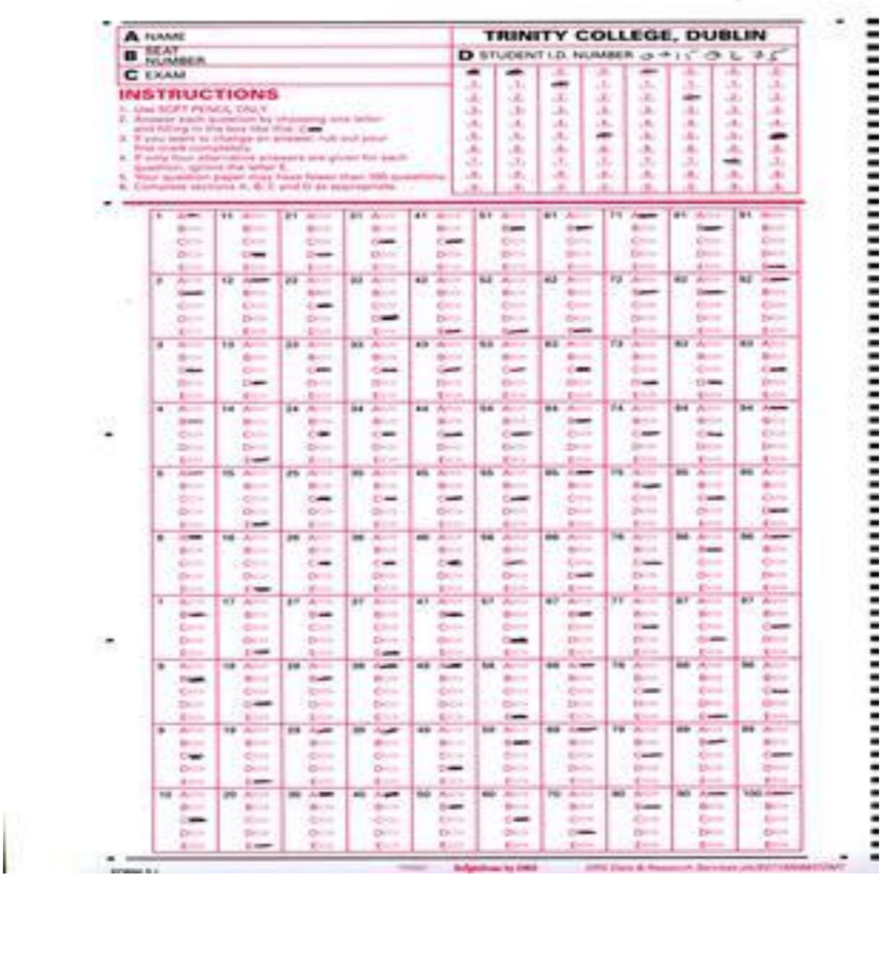
prints the item description and price on a paper tape of the customer. Although bar codes were once found primarily in supermarkets, there are a variety of other interesting applications. The bar code scanner is especially helpful in inventory control, as most products now display a Universal Product Code. This code is unique for cache type of product, making it easier to track inventory and sales.

FIGURE (2-7) Bar codes reader

2.2.2.2.2. Optical Mark Recognition:

Abbreviated ***OMR***, optical mark recognition is sometimes called ***mark sensing***, because a machine senses marks on a piece of paper. As a student, you may immediately recognize this approach as the technique used to score certain tests. Using a pencil, you make a mark in a specified box or space that corresponds to what you think is the answer. The answer sheet is then

graded by a device that uses a light beam to recognize the marks and convert them to computer- recognizable electrical signals. ***OMR*** comes useful when a high amount of forms to be processed is required in a short time.



2.2.2.2.3. Optical Character Recognition:

Abbreviated ***OCR***, optical character recognition devices also use a light source to read special characters and convert them into electrical signals to be sent to the central processing unit. The characters - letters, numbers, and special symbols - can be read by both humans and machines. They are often found on sales tags on store merchandise. It is mostly used in postal services as it reads the post code and sorts the mail automatically. It is also used for old documents that were written before computers were invented. A standard typeface for optical characters, called ***OCR-A***, has been established by the American National standards Institute Figure (2.8.). The Disadvantages of ***OCR*** is the human handwriting is rarely accurately

recognizable by OCR; the computer might confuse different shapes like '5' and 'S', and it is very costly to get through and costs more to proof-read and correct the data. The handheld wand reader is a popular input device for reading OCR-A.

FIGURE (2.8) optical character recognition.

There is an increasing use of wands in libraries, hospitals, and factories as well as in retail stores. In retail stores the wand reader is connected to a ***point-of-sale (POS)*** terminal. This terminal is somewhat like a ***cash register***, but it performs many more functions. When a clerk passes the wand reader over the price tag, the computer uses the input merchandise number to

retrieve a description (and possibly the price, if not on the tag) of the item. A small printer produces a customer receipt that shows the item description and price. The computer calculates the subtotal, the sales tax (if any), and the total. This information is displayed on the screen and printed on the receipt; notice that both screen and printer are output, so the ***POS*** terminal is a complex machine that performs both input and output functions. Finally, some ***POS*** terminals include a device that will accept a credit card, inputting account data from the magnetic strip on a customer's charge card.

2.2.2.2.4. Magnetic-Ink character Recognition:

Magnetic-ink character recognition (***MICR***) is similar to optical character recognition and is used exclusively by the banking industry. ***MICR***

readers are used to read and sort checks and deposits. You probably have noticed the account number and bank number encoded on all your checks and personalized deposit slips. The date of the transaction is automatically recorded for all checks processed that day; therefore, only the amount must by keyed in Figure (2.9). On a ***MICR*** inscriber a MICR reader-sorter reads the data on the checks and sorts the checks for distribution to other banks and customers or for further processing. Magnetic-ink character-recognition devices are used instead of OCR scanners because of MICR's increased speed and accuracy. The special magnetic characters permit the speeds that banks need to sort and process over 500 million checks each day.

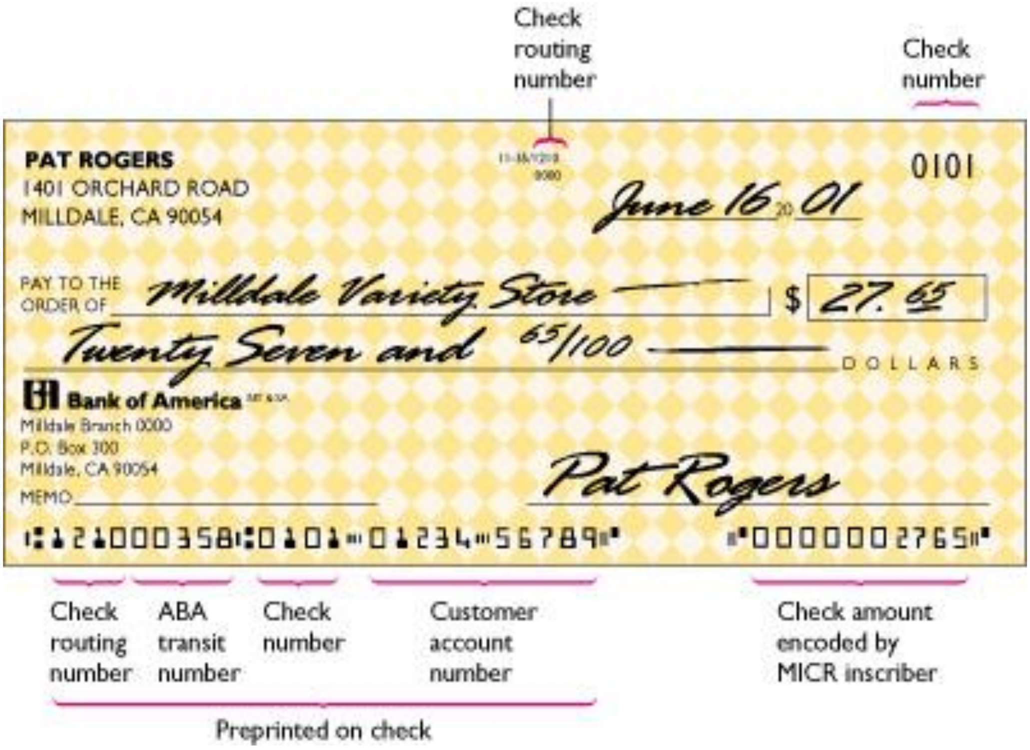


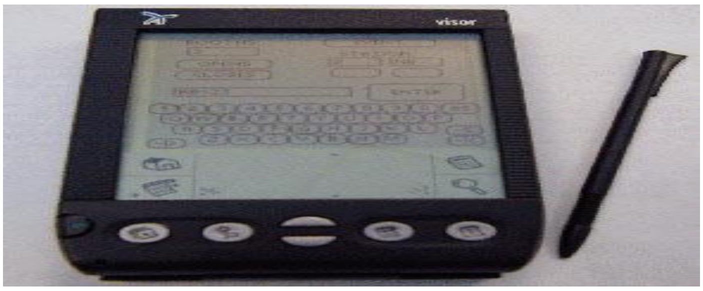
FIGURE (2.9) Magnetic-ink symbols on your check.

2.2.2.2.5. Data Collection Devices:

Another source of direct data entry is a data collection device, which may be located in a warehouse or factory or wherever the activity that is generating the data is located Figure (2.10). For example, factory employees can use a plastic

card to punch job data directly into a computerized time clock. This process eliminates intermediate steps and ensures that the data will be more accurate.

FIGURE (2.10) A data collection device.



2.2.2.2.6. Fax Machines:

A fax machine- or facsimile transmission machine - scans an image and sends it as electronic signals over telephone lines to a receiving fax machine, which re-creates the image on paper.

There are two types of fax machines - ***dedicated*** (stand alone) fax machines and ***fax modems:***

* ***Dedicated*** fax machines, generally called fax machines are specialized devices that do nothing except send and receive fax documents.
* A ***fax MODEM*** is installed as a circuit board inside the computer system cabinet. It is a modem with fax capability that enables the sending of signals directly from the computer to someone else's stands alone fax machine or

internal computer fax modem. The main disadvantage of a fax modem is that you cannot scan in outside documents. Thus, if a photo or a drawing needs to be faxed to someone, an image scanner is need in such cases.

2.2.2.3. Magnetic Stripes and Smart Cards:

The ***magnetic stripes*** on the back of charge cards and badges offer another means of data entry. The magnetic stripes are encoded with data appropriate for the application. For example, your account number and privacy code are encoded on a card for automatic teller machines.

Magnetic stripes contain much more data per unit of space than do printed characters or bar codes. The badge reader may also be on line to the computer. On-line badge readers maintain a chronological log of people entering or leaving

secured areas. The enhanced version of cards with a magnetic stripe is called the ***smart card***. The smart card, similar in appearance to other cards, contains a microprocessor that retains certain security and personal data in its memory at all times. The smart card can hold more information, and has some processing capability, and is almost impossible to duplicate.

2.2.2.4. Voice Recognition Device:

Speech recognition devices accept the spoken word through a microphone and convert it into binary code (0s and 1s) that can be understood by the computer Figure (2.11). Most speech recognition systems are speaker dependent—that is, they must be separately trained for each individual user. The speech recognition system "learns" the voice of the user, who speaks

isolated words repeatedly. The voiced words the system "knows" are then recognizable in the future. A key advantage of delivering to a computer in a normal speaking pattern is ease of use. Today, software is available to let computers take dictation from people who are willing to pause ... briefly ... between ... words; the best systems are quite accurate and equivalent to typing 70 words per minute. The major advantage of voice input is that the user does not have to key, move, or touch anything in order to enter data into the computer.

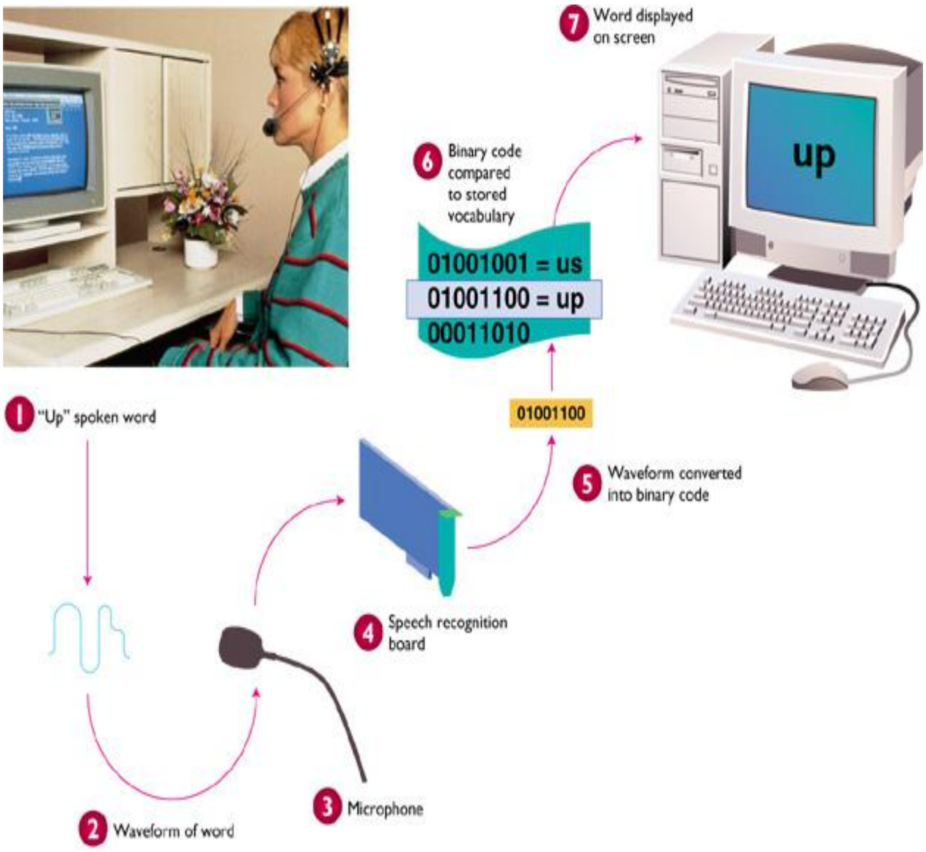


FIGURE (2.11). How voice input works

2.2.2.5. Portable Data Entry:

Portable data entry devices are hand-held and usually off-line, that is the portable device is not linked to the main computer during data collection activities.

The typical portable data-entry device would have a limited keyboard and some kind of storage capability for the data, usually random-access memory or magnetic cassette tape. After the data have been entered, the data entry device is linked with the host computer so that data can be uploaded (transmitted from the data entry device to host) for processing.

Chapter (3)
INSIDE THE COMPUTER

3.1. What is the central processing unit?
3.2. Memory.
3.3. How the CPU executes program instructions.
3.4. Storage locations and addresses.
3.5. Data representation: on/off.
3.6. Personal computer chips.
3.7. Speed and power.

LEARNING OBJECTIVES :

* learn the components of the central processing unit and how they work together and interact with memory.
* Understand how program instructions are executed by the computer.
* Understand how data is represented in the computer.
* Understand how the computer finds instructions and data.
* Understand the measures of computer processing speed and approaches that increase speed.
* To distinguish processors by their speed, memory capacity and word length.

3.1. ***WHAT IS THE CENTRAL PROCESSING UNIT?***

The computer does its primary work in a part of the machine we cannot see, a control center that converts data input to information output. This control center, called the ***Central Processing Unit*** (CPU), is a highly complex, extensive set of electronic circuitry that executes stored program instructions. All computers, large and small, must have a central processing unit. As Figure (3-1) shows, the central processing unit consists of two parts: ***The control unit*** and ***the arithmetic/logic unit***. Each part has a specific function.

Computers use two types of storage: ***primary storage*** and ***secondary storage***. The ***CPU*** interacts closely with ***primary storage***, or

memory, referring to it for both instructions and data. Technically, however, memory is not part of the CPU.

Memory holds data only ***temporarily***, at the time the computer is executing a program. Secondary storage holds ***permanent*** or ***semi-permanent*** data on some external magnetic or optical medium. The diskettes and CD-ROM disks that you have seen with personal computers are secondary storage devices, as are hard disks. Since the physical attributes of secondary storage devices determine the way data is organized on them.

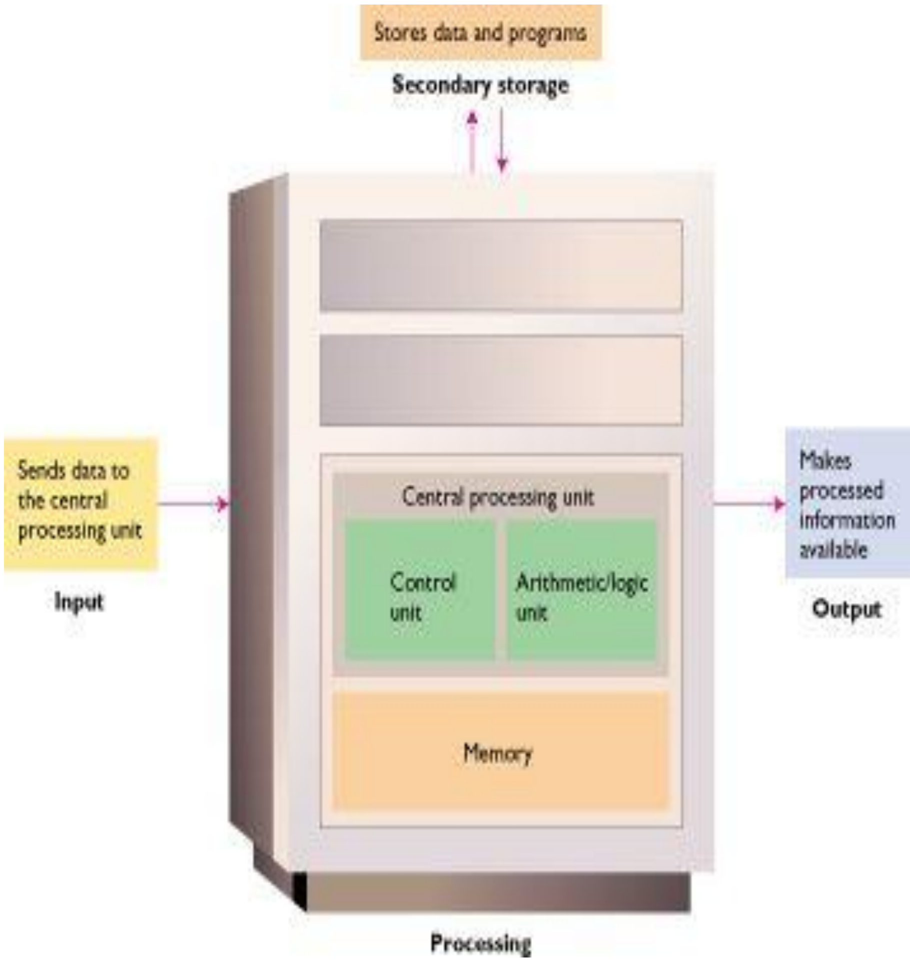


FIGURE (3-1) The central processing unit.

Now let us consider the components of the central processing unit.

3.1.1. The Control Unit:

Just as the processor is the nucleus of a computer system, the control unit is the nucleus of the processor. The control unit and the arithmetic and logic unit are the two fundamental sections of a processor. The control unit has three primary functions:

1- To read and interpret program instructions.
2- To direct the operation of internal processor components.
3- To control the flow of programs and data in and out of primary storage.

A program must first be loaded to primary storage before it can be executed. During execution the first in a sequence of program instructions is moved from primary storage to the control unit, where it is decoded and interpreted by the decoder. The control unit then directs

other components to carry out the operations necessary to execute the instructions.

The control unit contains high-speed working storage areas called ***registers*** that can store no more than a few bytes. The speed at which registers handle instructions and data is about 10 times faster than that of cache memory. They are used for a variety of processing functions. One register called the ***instruction register*** contains the instruction being executed. Other ***general-purpose registers*** store data needed for immediate processing. Registers also store status information. For example the program register contains the address of the next instruction to be executed. Registers facilitate the movement of data and instructions between primary storage, the control unit, and the arithmetic and logic unit.

3.1.2. The Arithmetic/ Logic Unit:

The Arithmetic/logic Unit (***ALU***) contains the electronic circuitry that executes all arithmetic and logical operations. The arithmetic/logic unit can perform ***four*** kinds of ***arithmetic operations***, or mathematical calculations: ***addition***, ***subtraction***, ***multiplication***, and ***division***. As its name implies, the arithmetic/logic unit also performs logical operations. A ***logical operation*** is usually a comparison. The unit can compare numbers, letters, or special characters. The computer can then take action based on the result of the comparison. This is a very important capability. It is by comparing that a computer is able to tell, for instance, whether there are unfilled seats on airplanes, and whether charge card customers have exceeded their credit limits.

Logical operations can test for six conditions:

Equal-to condition. (=) In a test for this condition, the arithmetic/logic unit compares two values to determine if they are equal.

Less-than condition. (<) To test for this condition, the computer compares values to determine if one is less than another..

Greater-than condition.(>)In this type of comparison, the computer determines if one value is greater than another.

**** Less than or equal to.***

* ***Greater than or equal to.***

**** Less than or greater than.*** Less than or greater than is the same as not equal to.

3.1.3. Registers: Temporary Storage Areas:

Registers are ***temporary*** storage areas for instructions or data. ***They are not a part of memory***; rather ***they are special additional***

storage locations that offer the advantage of speed. Registers work under the direction of the control unit to accept, hold, and transfer instructions or data and perform arithmetic or logical comparisons at high speed. The control unit uses a data storage register the way a store owner uses a cash register—as a temporary, convenient place to store what is used in transactions.

Computers usually assign special roles to certain registers, including:

***An accumulator,** which collects the result of computations.

***An address register,** which keeps track of where a given instruction or piece of data is stored in memory. Each storage location in memory is identified by an address, just as each house on a street has an address.

****A storage register,*** which temporarily holds data taken from or about to be sent to memory.

****A general-purpose register,*** which is used for several functions-arithmetic operations, for example.

Registers hold data immediately related to the operation being executed. Memory is used to store data that will be used in the near future. Secondary storage holds data that may be needed later in the same program execution or perhaps at some more remote time in the future.

3.2. MEMORY :

Memory is also known as ***primary storage***, ***primary memory***, ***main storage***, ***internal storage***, and ***main memory***. Memory is the part of the computer that holds data and instructions for processing. Although closely associated with the central processing unit, memory is separate from

it. Memory stores program instructions or data for only as long as the program they pertain to is in operation. How do data and instructions get from an input device into memory? The control unit sends them. Likewise, when the time is right, the control unit sends these items from memory to the arithmetic/logic unit, where an arithmetic operation or logical operation is performed. After being processed, the information is sent to memory, where it is held unit it is ready to be released to an output unit.

3.3. HOW THE CPU EXECUTES PROGRAM INSTRUCTIONS :

Most computers today can execute only one intrusion at a time, though they execute it very quickly. Many personal computers can execute instructions in less than one-millionth of a

second, whereas those speed demons known as supercomputers can execute instructions in less than one-billionth of a second.

Before an instruction can be executed, program instructions and data must be placed into memory from an input device or a secondary storage device (the process is further complicated by the fact that, as we noted earlier, the data will probably make a temporary stop in a register). As Figure (3-3) shows, once the necessary data and instruction are in memory, the central processing unit performs the following ***four steps*** for each instruction:

1- The control unit ***fetches*** (gets) the instruction from memory.

2- The control unit ***decodes*** the instruction (decides what it means) and directs that the

necessary data be moved from memory to the arithmetic/logic unit.

These first two steps together are called instruction time, or I-time.

3- The arithmetic/logic unit executes the arithmetic or logical instruction. That is, the ALU is given control and performs the actual operation on the data.

3- The arithmetic/logic unit ***stores*** the result of this operation in memory or in a register.

Steps 3 and 4 together are called execution time, or E-time.

The control unit eventually directs memory to release the result to an output device or a secondary storage device.

The combination of I-time and E-time is called the machine cycle.

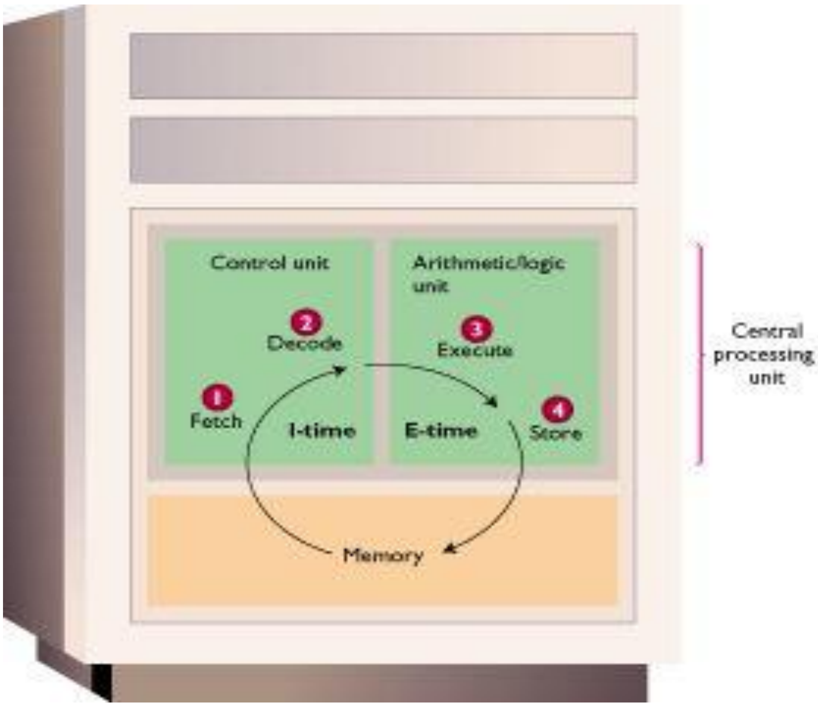


FIGURE (3-2) the machine cycle.

3.4. STORAGE LOCATIONS AND ADDRESSES :

The location in memory for each instruction and each piece of data is identified by an address. That is, each location has an address number, like the mailboxes in front of an apartment house. And, like the mailboxes, the address numbers of

the locations remain the same, but the contents (instructions and data) of the locations may change. That is, new instructions or new data may be placed in the locations when the old contents no longer need to be stored in memory. Unlike a mailbox, however, a memory location can hold only a fixed amount of data; an address can hold only one number or one word. Figure (3-3) shows how a program manipulates data in memory. A payroll program, for example, may give instructions to put the rate the rate of pay in location 3 and the number of hours worked in location 6. To compute the employee's salary, then, instructions tell the computer to multiply the data in location 3 by the data in location 6 and move the result to location 8. The choice of locations is arbitrary-any locations that are not already spoken for can be used. Programmers

using programming languages, however, do not have to worry about the actual address numbers, because each data address is referred to by a name. The name is called a symbolic address. In this example, the symbolic addresses are Rate, Hours, and Salary.

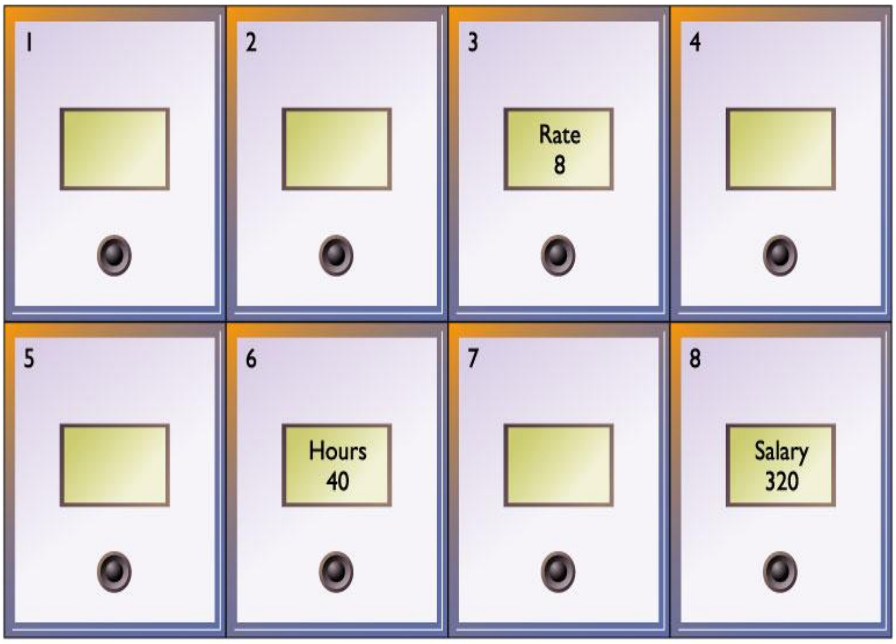


FIGURE (3-3) Addresses like mailboxes.

3.5. DATA REPRESENTATION : ON/OFF :

We are accustomed to thinking of computers as complex mechanisms, but the fact is that these machines basically know only two things: on and off. This two-state ***on/off*** system is called a ***binary system***. Using the two states-which can be represented by electricity turned on or off-the computer, can construct sophisticated ways of representing data. Let us look at one way the two states can be used to represent data. Whereas the ***decimal number*** system has a base of 10 (with the ten digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9), the ***binary system*** has a ***base of 2***. This means it contains only ***two digits, 0 and 1***, which correspond to the two states off and on. Combinations of 0s and 1s represent larger numbers Figure (3-4).

BINARY EQUIVALENT OF DECIMAL NUMBERS 0-15	
Decimal	**Binary**
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

FIGURE (3-4) Decimal and binary equivalents.

3.5.1. Bits, Bytes, and Words:

Each ***0 or 1*** in the binary system is called a ***bit*** (for binary digit). The bit is the basic unit for storing data in computer memory ***-0 means off, 1 means on***. Notice that since a bit is always either on or off, a bit in computer memory is always storing some kind of data.Since single bits by themselves cannot store all the numbers, letters, and special characters (such as $ and ?) that a computer must process, ***the bits are put together in a group, called a byte*** (pronounced "bite"). ***There are usually 8 bits in a byte***. ***Each byte usually represents one character of data-a letter, digit, or special character.***

- Computer manufacturers express the capacity of memory and storage in terms of the number of bytes it can hold. The number of bytes can

be expressed as kilobytes. Kilo represents 2 to the tenth power (2^{10}), or 1024. Kilobyte is abbreviated KB, or simply K. A kilobyte is 1024 bytes. Thus, the memory of a 640K computer can store 640×1024, or 655,360 bytes. Memory capacity may also be expressed in terms of megabytes (1024×1024 bytes).One megabyte abbreviated MB, means, roughly, one million bytes. With storage devices, manufacturers sometimes express memory amounts in terms of gigabytes (abbreviated GB)-billions of bytes. Terabyte (TB) consists of approximately 1,000,000,000,000 bytes.

Term	Abbreviation	Approximate Number of Bytes
Kilobyte	K (or KB)	one thousand
Megabyte	MB	one million
Gigabyte	GB	one billion
Terabyte	TB	one trillion
Petabyte	PB	one quadrillion

3.5.2. Encoding Systems: Combining Bits To Form Bytes:

3.5.2.1. EBCDIC and ASCII:

Computers do not talk to each other in English, Spanish, or French. They have their own languages, which are better suited to electronic communication. In these languages, bits are combined according to an encoding system to represent letters (Alpha characters), numbers (numeric characters), and special characters (such

as *, $, +, and &). For example, in the eight-bit ***EBCDIC*** encoding system (Extended Binary-Coded Decimal Interchange Code-pronounced IB-see-dik), which is used primarily in mainframe computers, 11000010 represents the letter B, and 11110011 represents a decimal number 3. In the seven-bit ***ASCII*** encoding system (American Standard Code for Information Interchange-pronounced As-key), which is used primarily in micros and data communications, a B and a 3 are represented by 1000010 and 0110011, respectively. There is also an eight-bit version of ASCII called ***ASCII-8.***

Letters, numbers, and special characters are collectively referred to as ***alphanumeric*** characters. Alphanumeric characters are encoded

into a bit configuration on input so that the computer can interpret them.

When you press the letter B on a PC keyboard, the B is transmitted to the processor as a coded string of binary digits (for example, 1000010 in ASCII). The characters are decoded on output so we can interpret them. For example, a monitor's device controller will interpret an ASCII 0110011 as a 3 and display a 3 on the screen. This coding, which is based on a particular encoding system, equates a unique series of bits and no-bits with a specific character. Just as the words mother and father are arbitrary English-language character strings that refer to our parents, 11000010 is an arbitrary EBCDIC code that refers to the letter B. The combination of bits used to represent a character

is called a byte. Figure (3-5) shows the binary value (the actual bit configuration) and the decimal equivalent of commonly used characters in both EBCDIC and ASCII.

The seven-bit ASCII can represent up to 128 characters (2^7). EBCDIC and ASCII-8 can represent up to 256 characters (2^8). Although the English language has considerably fewer than 128 printable characters, the extra bit configurations are needed to represent non-character images (for example, a bullet point or paragraph symbol) and to communicate a variety of activities (such as ringing a bell, signaling the computer to accept a piece of datum).

Character	ASCII	EBCDIC
0	0011 0000	1111 0000
1	0011 0001	1111 0001
2	0011 0010	1111 0010
3	0011 0011	1111 0011
4	0011 0100	1111 0100
5	0011 0101	1111 0101
6	0011 0110	1111 0110
7	0011 0111	1111 0111
8	0011 1000	1111 1000
9	0011 1001	1111 1001
A	0100 0001	1100 0001
B	0100 0010	1100 0010
C	0100 0011	1100 0011
D	0100 0100	1100 0100
E	0100 0101	1100 0101
F	0100 0110	1100 0110
G	0100 0111	1100 0111
a	0110 0001	1000 0001
b	0110 0010	1000 0010
c	0110 0011	1000 0011
d	0110 0100	1000 0100
e	0110 0101	1000 0101
f	0110 0110	1000 0110
g	0110 0111	1000 0111
!	0010 0001	0101 1010
#	0010 0011	0111 1011
$	0010 0100	0101 1011
+	0010 1011	0100 1110

FIGURE (3-5) ASCII Codes

3.5.2.2. The Nibble:

The eight-bit EBCDIC and ASCII-8 encoding systems are endowed with an interesting and useful quality. Only four bit positions are needed to represent the 10 decimal digits. Therefore, a single numeric digit can be stored in a half-byte, or a nibble, as it is sometimes called. This enables us to store data more efficiently by "packing" two decimal digits into one eight-bit byte .Because two decimal digits can be packed into one byte, a byte is not always the same as a character. Even so, the terms byte and character are often used interchangeably, with an implied understanding that some bytes may contain two numeric characters.

3.5.2.3. Parity checking:

Within a computer system, data in the form of coded characters are continuously transferred at high rates of speed between the computer, the input/output (I/O) and storage devices, and the remote workstations. Each device uses a built-in checking procedure to help ensure that the transmission is complete and accurate. This procedure is called parity checking.

Logically, an ASCII character may have seven bits, but physically there are actually eight bits transmitted between hardware devices. The extra parity bit, which is not part of the character code, is used in the parity-checking procedure to detect whether a bit has been accidentally changed, or "dropped," during transmission. A dropped bit results in a parity error.

3.5.3. Numbering Systems and Computers:

We humans use a decimal, or base-10, numbering system, presumably because people have 10 fingers. Then in all probability we would be using the ***octal*** numbering system, which has a base of ***8***.

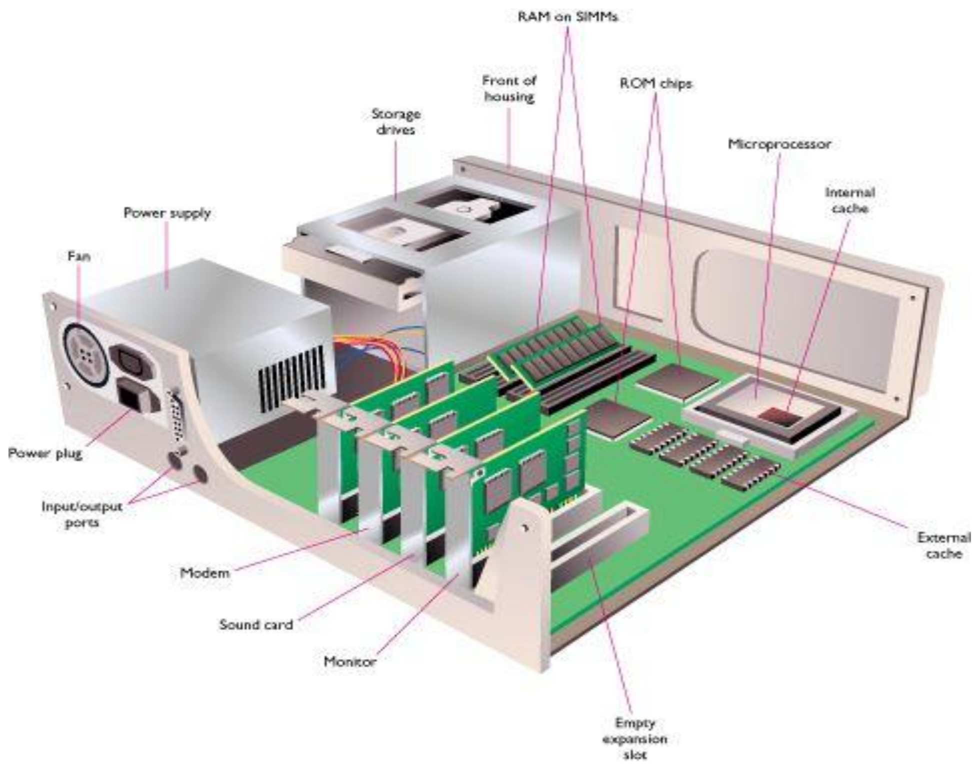
The ***hexadecimal*** (base-***16***) numbering system is used as shorthand to display the binary contents of both primary and secondary storage.

Computers ***operate*** in ***binary*** and ***communicate*** to us in <u>***decimal***</u>. A special program translates decimal into binary on input, and binary into decimal on output.

3.6. <u>PERSONAL COMPUTER CHIPS :</u>

The chips discussed here would be attached to the ***motherboard***, the flat board within the personal computer housing that holds the

computer circuitry. The motherboard, also called the main circuit board, is a mass of chips and connections that organize the computer's activities. Memory chips also may be attached to boards that can be inserted later to provide supplementary memory.



__Motherboard__

3.6-1. Microprocessors:

A miniaturized central processing unit can be etched on a chip, a tiny square of silicon, hence the term computer on a chip. A central processing unit, or ***processor***, on a chip is a ***microprocessor*** Figure (3-12), often called a logic chip when it is used to control specialized devices (such as the fuel system of a car). Microprocessors contain tiny **transistors**, electronic switches that may or may not allow current to pass through. ***Microprocessors usually include these key components***: ***a control unit*** and an ***arithmetic/logic unit*** (the central processing unit), ***registers***, and a ***clock***. (Clocks are often on a separate chip in personal computers). Notably missing is memory, which usually comes on its own chips.

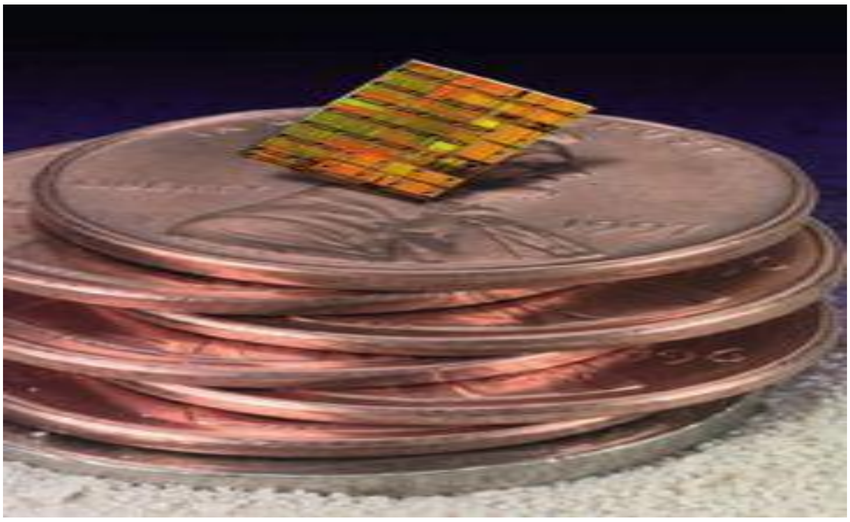


FIGURE (3-12) a microprocessor chip

3.6.2. Memory Components:

Historically, memory components have evolved from primitive vacuum tubes to today's modern semiconductors.

3.6.2.1. Semiconductor Storage:

Most modern computers use ***semiconductor*** storage because it has several *advantages*: ***reliability***, ***compactness***, ***low cost***, and ***lower power usage***. Semiconductor storage has one

major *disadvantage*: It is ***volatile***-that is, semiconductor storage requires continuous electric current to represent data. If the current is interrupted, the data is lost. Semiconductor storage is made up of thousands of very small circuits-pathways for electric currents-on a silicon chip. One important type of semiconductor design is called Complementary Metal Oxide Semiconductor (***CMOS***). This design is noted for using little electricity. This makes it especially useful for computers requiring low power consumption, such as portable computers.

3.6.2.2 RAM and ROM:

Random-Access Memory (RAM) ***temporarily*** keeps the instructions and data for whatever programs you happen to be using at the moment.

The data can be accessed in an easy and speedy manner. RAM is usually ***volatile***, this means that its contents are lost once the power is shut off. RAM can be erased or written over at will by the computer software.

The more RAM in your computer, the larger the programs you can run. In recent years the amount of RAM storage in a personal computer has increased dramatically. Most current computers have enough RAM to run several applications simultaneously, a process called ***multitasking***. In general, the more memory your computer has the more (and bigger) tasks the computer can do.

RAM is often divided into two types: ***static*** RAM (SRAM) and ***dynamic*** RAM (DRAM). DRAM must be constantly refreshed (recharged)

by the central processing unit or it will lose it's contents-hence the name dynamic. Although SRAM is faster, DRAM is used in most personal computer memory because of its size and cost advantages .

FIGURE (3.13) DRAM chip. This DRAM

Read - Only Memory (ROM) contains programs and data are permanently recorded into this type of memory at the factory; they can be

read and used, but they cannot be changed by the user. For example, a personal computer probably has a program for calculating square roots in ROM. ROM is ***nonvolatile***-its contents do not disappear when the power is turned off.

A variation of ROM is ***programmable read-only memory (PROM).*** PROM is ROM into which you the user, can load "read-only" programs and data. Some microcomputer software packages, such as electronic spreadsheets, are available as PROM units as well as on diskette. Once a program is loaded to PROM, it is seldom, if ever, changed. However, if you need to be able to revise the contents of PROM, there is ***EPROM***, ***erasable PROM***.

3.7. __SPEED AND POWER :__

The characteristic of speed is universally associated with computers. Power is a derivative of speed, as well as other factors such as memory size. What makes a computer fast? Or, more to the point, what makes one computer faster than another? ***__Several factors are involved, including microprocessor speed, bus line size, and availability of cache.__*** A user who is concerned about speed will want to address all of these more sophisticated approaches to speed include flash memory, RISC computers, and parallel processing. We will discuss each approach in turn.

3.7.1. Computer Processing Speeds:

Although all computers are fast, there is a wide diversity of computer speeds. The execution

of an instruction on a very slow computer may be measured in less than a ***millisecond***, which is one-thousandth of a second.

Most computers can execute an instruction measured in ***microseconds***, *one-millionth of a second*. Some modern computers have reached the *nanosecond* range-*one-billionth of a second*. Still to be broken is the ***picoseconds*** barrier-*one-trillionth of a second.*

Microprocessor speeds are usually expressed in ***megahertz*** (***MHZ***), ***millions of machine cycles per second***. Thus, a personal computer listed at 500 MHz has a processor capable of handling 500 million machine cycles per second. A top-speed personal computer can be much faster, with some even approaching ***GHz*** (*gigahertz--billions of machine cycles per second*) speeds.

Another measure of computer speed is ***MIPS***, which stands for one *Million Instructions Per Second.* For example, a computer with speed of 0.5 MIPS can execute 500,000 instructions per second. High-speed personal computers can perform at 100 MIPS and higher. MIPS are often a more accurate measure than clock speed, because some computers can use each tick of the clock more efficiently than others. A third measure of speed is the ***megaflop***, which stands for *one million floating-point operations per second*. It measures the ability of the computer to perform complex mathematical operations.

3.7.2. Bus Lines :

The computer term bus is borrowed from its common meaning-a mode of transportation. A bus line is a set of parallel electrical paths that

internally transports data from one place to another within the computer system. The amount of data can be carried at one time is called the bus width-the number of electrical paths. The greater the width, the more data can be carried at a time. In general, the larger the word size or bus, the more powerful the computer. A larger bus size means:

- The computer can transfer more data at a time, making the computer faster.
- The computer can reference larger numbers, allowing more memory.
- The computer can support a greater number and variety of instructions.

3.7.3. Cache :

A cache (pronounced “cach") ***is a relatively small amount of very fast memory designed for***

<u>the specific purpose of speeding up internal transfer of data and software instructions</u>. Think of ***<u>cache as a selective memory</u>***: The data and instructions stored in cache are those that are most recently and/or most frequently used. When the processor first requests data or instructions, these must be retrieved from main memory, which is delivered at a pace that is relatively slow compared to the microprocessor. As they are retrieved, those same data/instructions are stored in cache. The next time the microprocessor needs data or instructions, it looks first in cache; if the needed items can be found there, they can be transferred at a rate that far exceeds a trip from main memory. Of course, ***<u>cache is not big enough to hold everything,</u>*** so the wanted data or instructions may not be there. Like RAM, *<u>cache is a high-speed holding area for program</u>*

instructions and data. However, cache memory uses a technology that is about 10 times faster than RAM and about 100 times more expensive. With only a fraction of the capacity of RAM, cache memory holds only those instructions and data that are likely to be needed next by the processor.

Cache speeds performance depends on a number of factors, including the size of the cache, the speed of the memory chips in the cache, and the software being run.

3.7.4. Flash Memory:

A long-standing speed problem has been the rate of accessing data from a secondary storage device such as a disk, a rate significantly slower than internal computer speeds. It seemed unimaginable that data might someday be stored

on nonvolatile memory chips-nonvolatile RAM-close at hand. A breakthrough has emerged in the form of nonvolatile flash memory. Flash chips are currently being used in cellular phones and cockpit flight recorders, and they are replacing disks in some handheld computers. Flash memory chips are being produced in credit-card like packages, which are smaller than a disk drive and require only half the power. Since data and instructions will be ever-closer to the microprocessor, conversion to flash memory chips would have a pivotal impact on a computer's processing speed.

3.7.5. RISC Technology:

It flies in the face of computer tradition: Instead of reaching for more variety, more power, more everything-for-everyone, proponents of

RISCs-***<u>Reduced Instruction Set Computers</u>***-suggest that we could get by with a little less. In fact, reduced instruction set computers offers only a small subset of instructions; the absence of bells and whistles increases speed. So we have a radical back-to-basics movement in computer design.

3.7.6. Parallel Processing:

The ultimate speed solution is parallel processing, a method of using several processors at the same time. Consider the description of computer processing you have seen so far in this chapter: The processor gets an instruction from memory, acts on it, returns processed data to memory, and then repeats the process. This is conventional *<u>serial processing</u>*, the execution of one instruction at a time. A variation on this approach

is *pipelining*, in which an instruction's actions--fetch, decode, execute, store--need not be complete before the next instruction is begun. For example, once fetch is complete for an instruction and it moves to decode, fetch is begun for the next instruction.

The problem with the conventional computer is that the single electronic pathway, the bus line, acts like a bottleneck. The computer has a one-track mind because it is restricted to handling one piece of data at a time. For many applications, such as simulating the airflow around an entire airplane in flight, this is an exceedingly inefficient procedure. A better solution? Many processors, each with its own memory unit, working at the same time: parallel processing. Some parallel processors are capable of operating

in terms of ***teraflops***--that is, *trillions of floating-point instructions per second*. Recall, for comparison, that a megaflop is a mere one million floating-point operations per second. A number of parallel processors are being built and sold commercially. However, do not look for parallel processing in personal computers just yet. Thus far, this technology is limited to larger computers.

Chapter (4)

AUXILARY STORAGE

LEARNING OBJECTIVES

- To distinguish between primary secondary storage
- Understand the principle types of secondary storage
- Understand how data is stored on a disk

4.1 What is auxiliary storage?

Computer storage can be classified into ***two*** types: ***main memory*** and ***auxiliary storage***. *Auxiliary storage* devices provide a more *permanent* form of storage than main memory because they are *nonvolatile*. Auxiliary storage devices can be used as both input and output devices. A ***storage medium*** is the physical material on which items are kept. A ***storage device*** is the computer hardware that records and retrieves items to and from a storage medium. When storage devices *transfer* items from a *storage medium into memory* – a process called ***reading*** – they function as sources of ***input***. When storage devices *transfer* items from *memory to a storage medium* – a process called ***writing*** – they function as sources of ***output***. Types of storage media include floppy disks,

hard disks, compact discs, tape, PC Cards, microfilm, and microfiche.

4.2 The Benefits of Secondary Storage

Secondary storage, sometimes called ***auxiliary storage***, is storage separate from the computer itself, where you can store software and data on a *semi permanent* basis. Secondary storage is necessary because *memory*, or primary storage, can be used only *temporarily*. However, you probably want to reuse information you have derived from processing; that is why secondary storage is needed.

The ***benefits*** of secondary storage can be summarized as follows:

- ***Space*****:** A simple diskette for a personal computer can hold the equivalent of 500 printed pages, or one book.

- ***Reliability***: Data in secondary storage is basically safe, since secondary storage is physically reliable.
- ***Convenience:*** With the help of a computer, authorized users can locate and access data quickly.
- ***Economy***: It is less expensive to store data on tape or disk (the principal means of secondary storage) than to buy and house filing cabinets.

4.3 Types of Auxiliary Storage Media

These benefits apply to all the various secondary storage devices, some devices are better than others.

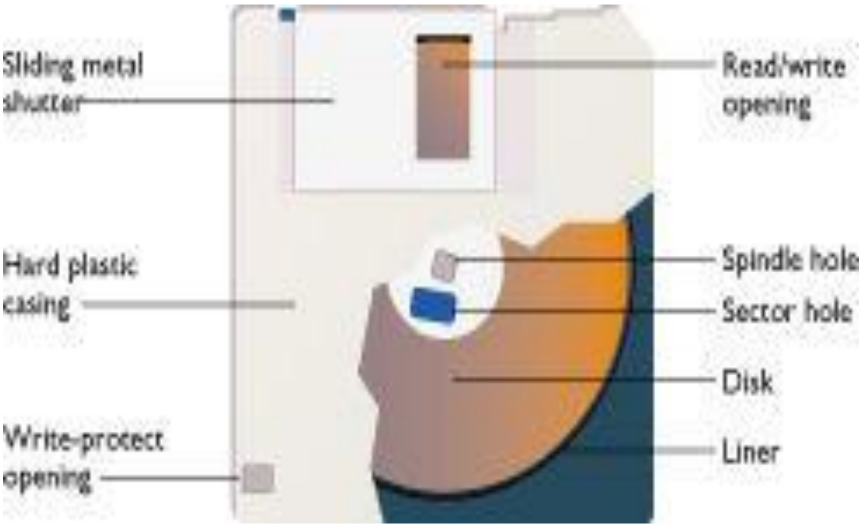
4.3.1. Magnetic Disk Storage

Diskettes and hard disks are magnetic media; that is, they are based on a technology of

representing data as magnetized spots on the disk--with a magnetized spot representing a 1 bit and the absence of such a spot representing a 0 bit. ***Data is stored in tracks and sectors***. The number of tracks per surface varies with the particular type of disk. *Reading* data from the disk means converting the magnetized data to electrical impulses that can be sent to the processor. *Writing* data to disk is the opposite; it involves sending electrical impulses from the processor to be converted to magnetized spots on the disk.

Diskettes: A *diskette* is made of flexible Mylar and coated with iron oxide, a substance that can be magnetized. *A diskette can record data as magnetized spots on tracks on its surface*. Diskettes became popular along with the personal computer. Most computers use the 3 1/2-inch

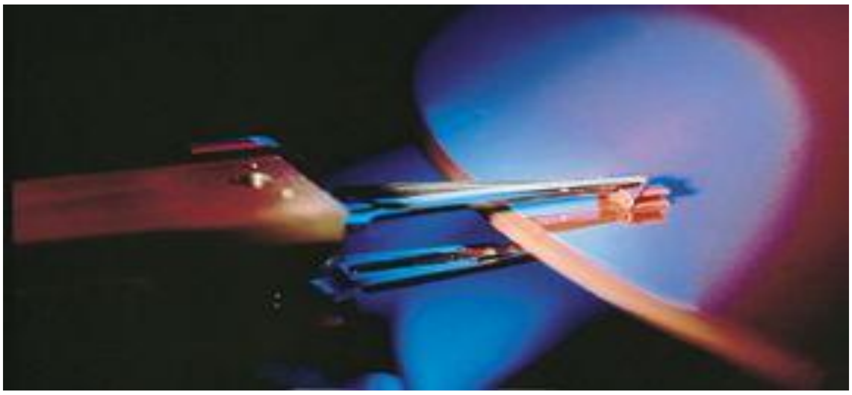
diskette, whose capacity is 1.44 megabytes of data. A floppy disk is a type of magnetic media because it uses magnetic patterns to store items. To protect the data and programs stored on a floppy disk is to use the ***write –protect notch***. The key *advantage* of diskettes is portability. Diskettes easily transport data from one computer to another. A new standard could be a higher-capacity disk whose drive can handle both the new disk type and the traditional 3 1/2-inch disk. However, the technology with a head start is ***Iomega's Zip drive***, already installed by 20 million users. The ***Zip disk*** is larger and thicker than a 3.5-inch floppy disk and can store 100 MB or 250 MB of data. The *disadvantage* of the Zip drive is that it is not compatible with 3 1/2-inch diskettes.

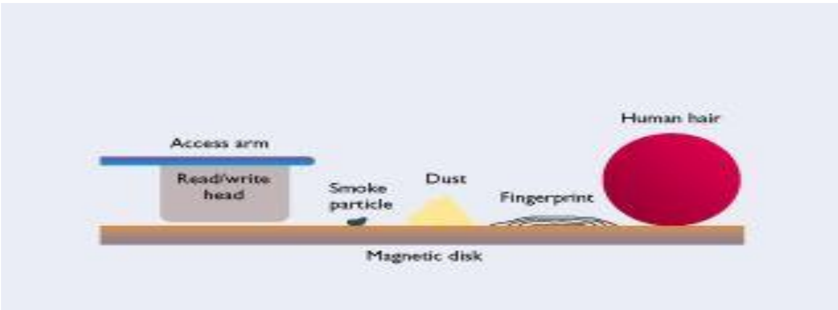

Sliding metal shutter
Read/write opening
Hard plastic casing
Spindle hole
Sector hole
Disk
Write-protect opening
Liner

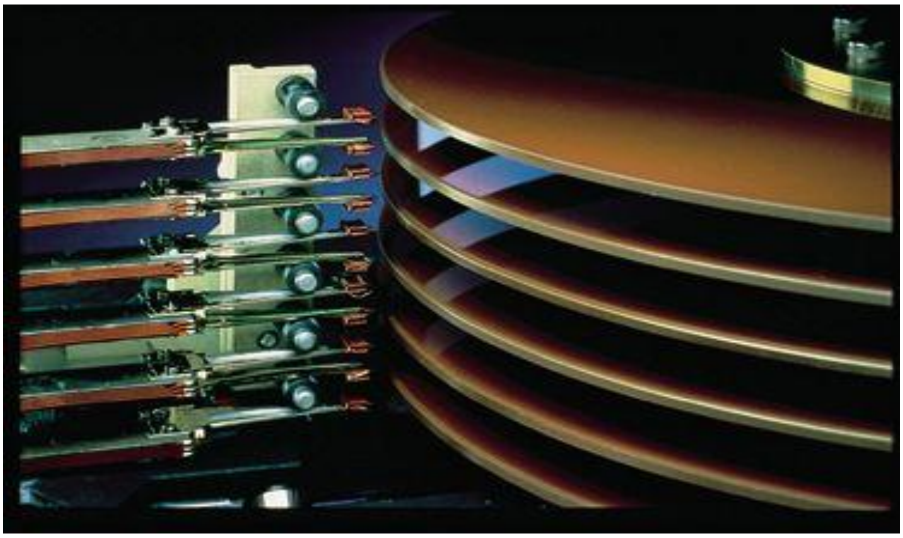
Hard Disks

A ***hard disk*** is a metal platter coated with magnetic oxide that can be magnetized to represent data, and consists of several inflexible, circular *platters* that store items electronically. A *platter* in a hard disk is made of aluminum, glass, or ceramic and is coated with a material that allows items to be recorded magnetically on its surface. ***A disk drive*** is a device that allows data to be read from a disk or written on a disk. The mechanism for reading or writing data on a disk is ***an access arm;*** it moves a read/write head into position over a particular track. The ***read/write head*** on the end of the access arm hovers just above the track but does not actually touch the surface. When a read/write head does accidentally touch the disk surface, it is called a ***head crash*** and data can be destroyed. A

removable hard disk is a disk drive in which a plastic or metal case surrounds the hard disk so that you can remove it from the drive. No storage system is completely safe, but a ***redundant array of independent disks***, or simply ***RAID***, comes close. *RAID* storage uses several small hard disks that work together as a unit. The most basic RAID system--RAID level 1--simply duplicates data on separate disk drives, a concept called ***disk mirroring***. Thus no data is lost if one drive fails. This process is reliable but expensive.




Human hair
Access arm
Read/write head
Smoke particle
Dust
Fingerprint
Magnetic disk

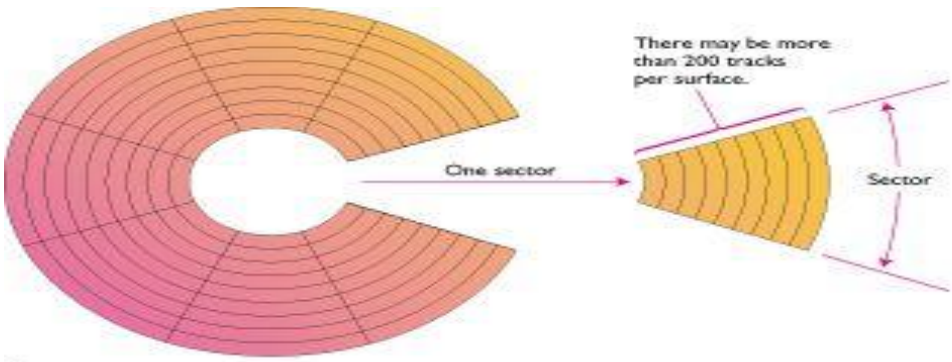


4.3.2. How Data Is Organized on a Disk

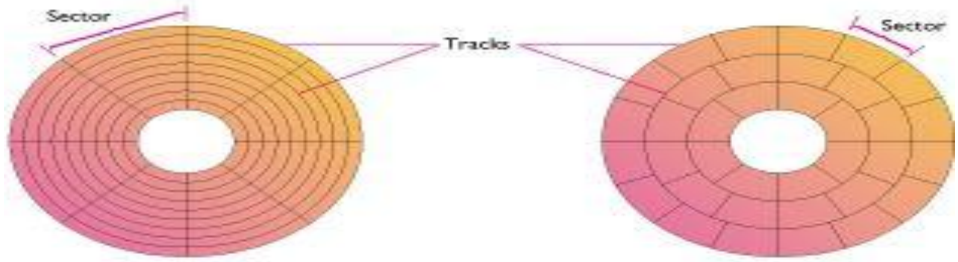
There is more than one way of physically organizing data on a disk. The methods considered here are the ***sector method*** and the ***cylinder method***.

The Sector Method **:** In the sector method each *track* on a disk is divided into *sectors* that hold a specific number of characters. Data on the track is accessed by referring to the surface number, track number, and sector number where the data is stored. The sector method is used for diskettes.

Zone recording takes maximum advantage of the storage available by dividing a disk into *zones* and assigning more sectors to tracks in outer zones than to those in inner zones. Since each sector on the disk holds the same amount of data, more sectors mean more data storage than if all tracks had the same number of sectors.



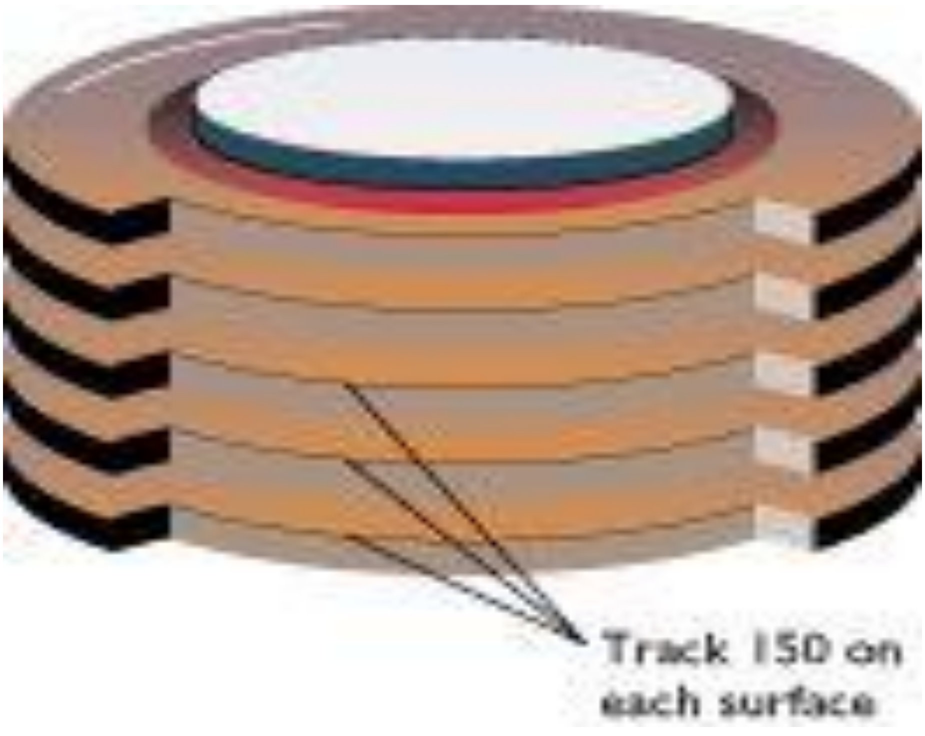
(a)



(b)

<u>The Cylinder Method</u> : A way to organize data on a disk pack is the *<u>cylinder method,</u>*. The organization in this case is *vertical*. The purpose is to reduce the time it takes to move the access arms of a disk pack into position. Once the access arms are in position, they are in the same vertical position on all disk surfaces. The cylinder method, then, means that all tracks of a certain

cylinder on a disk pack are lined up one beneath the other, and all the vertical tracks of one cylinder are accessible by the read/write heads with one positioning of the access arm mechanism. Tracks within a cylinder are numbered according to this vertical perspective, from 0 on the top down to the last surface on the bottom.



4.3.3. Optical Disk Storage

The explosive growth in storage needs has driven the computer industry to provide inexpensive and compact storage with greater capacity. This demanding shopping list is a description of the ***optical disk***. Optical storage technology is categorized according to its *read/write* capability. ***Read-only media*** are disks recorded by the manufacturer and can be read from but not written to by the user.

Write-once, read-many media, also called ***WORM media***, may be written to once. Once filled, a *WORM* disk becomes a read-only medium. A *WORM* disk is non erasable.

A hybrid type of disk, called ***magneto-optical (MO)***, combines the best features of magnetic and optical disk technologies. A *magneto-optical*

disk has the high-volume capacity of an optical disk but can be written over like a magnetic disk.

CD-ROM

A variation on optical storage technology is the ***CD-ROM***, for ***Compact Disk Read-Only Memory***.

CD-ROM is a compact disc that uses the same laser technology as audio CDs. *CD-ROM* cannot be used in your personal computer's diskette drive; you must have a ***CD-ROM drive*** on your computer. Although *CD-ROMs* are read-only, a different technology called ***CD-R (Compact Disc-Recordable)*** permits writing on optical disks. CD-R technology requires a CD-R drive, CD-R disks, and the accompanying software. Once a CD-R disk is written on, it can be read not only by the CD-R drive but by any CD-ROM drive. Another variation, ***CD-RW***,(***Compact***

Disc-ReWriteable) is more flexible, permitting reading, writing, and rewriting.

DVD-ROM: The new storage technology that outpaces all others is called ***DVD-ROM***, for ***digital video disk.*** *DVD-ROM* drive can also read *CD-ROMs*. Operating very much like CD-ROM technology, DVD uses a laser beam to read microscopic spots that represent data. The benefits of this storage capacity are many--full-length movies and exquisite sound. Audio quality on DVD is comparable to that of current audio compact disks. DVDs will eventually hold high-volume business data. It is just a matter of time until all new personal computers will come with a DVD drive as standard equipment. If you have a CD-ROM or a DVD-ROM drive, you are on your way to one of the computer industry's great adventures: *multimedia*.

Multimedia

In computing ***multimedia*** is the presentation of information by a computer system using *text*, *sound* and *graphics*.

Text		**Sound**		**Graphics**
Writing	+	Speech	+	Pictures
		Music		Animations
		Noises		Videos

Software described as ***Multimedia*** typically presents information with text, illustrations, photos, narration, music, animation, and film clips. Until the optical disk, placing this much data on a disk was impractical.

Multimedia Requirements

To use multimedia software, you must have the *proper hardware*, *CD-ROM or DVD-ROM drive*, *sound card* or sound chip (installed internally) and *speakers*, which may rest externally on either side of the computer or be

built into the computer housing. Special software accompanies the drive and sound card.

USB – Flash drive

A ***flash*** drive is a small compact memory chip that plugs into the USB port of a computer. *Flash drives* allow data to be stored, erased and re-written to many times. Flash drives are portable backing storage devices that have a storage capacity ranging from 64 megabytes up to 16 gigabytes.

Figure 2.4 Flash Disk/USB Key *Flash memory is used to conveniently carry electronic documents and other files.*

SOURCE: Istock.

Magnetic Tape Storage

Magnetic tape looks like the tape used in music cassettes--plastic tape with a magnetic coating. As in other magnetic media, data is stored as extremely small magnetic spots. Tapes come in a number of forms, including 1/2-inch-wide tape wound on a reel, 1/4-inch-wide tape in data cartridges and cassettes, and tapes that look like ordinary music cassettes but are designed to store data instead of music. ***The amount of data on a tape is expressed in terms of density***, ***which is the number of characters per inch (CPI) or bytes per inch (BPI)*** that can be stored on the tape. The highest-capacity tape is the ***digital audio tape***, or ***DAT***, which uses a different method of recording data. Using a method called ***helical scan recording***, DAT wraps around a rotating read/write head that spins vertically as it

moves. This places the data in diagonal bands that run across the tape rather than down its length. This method produces high density and faster access to data. A ***magnetic tape unit*** that might be used with a mainframe. The tape unit reads and writes data using a ***read/write head***. When the computer is writing on the tape, the ***erase head*** first erases any data previously recorded.

Backup Systems:

With any method of data storage, a ***backup system***--a way of storing data in more than one place to protect it from damage and errors--is vital. Magnetic tape is used primarily for backup purposes. For personal computer users, an easy and inexpensive way to back up a hard disk file is simply to copy it to a diskette or *Zip disk* whenever it is updated.

Chapter 5
OUTPUT FROM THE COMPUTER

LEARNING OBJECTIVES:

- Describe the common types of output.
- List the common types of reports and graphs are used for output.
- Describe the basic forms of soft copy and hard copy output.
- Describe the hardware used to produce computer's output.
- Describe printed output, and in particular the classification of printers.

Output is the information produced by a computer from a specific input. Output units are used to deliver the information from the central processing unit, and communicate such information to man or other computer system.

5.1. WHAT IS OUTPUT?

Output is data that has been processed into a useful form called information that can be used by a person or a machine.

5.2. COMMON TYPES OF OUTPUT:

The type of output generated from the computer depends on ***the needs of the user***, and ***the hardware*** and ***software that are used***. ***The two most common types of output are reports and graphics.***

5.2.1. Reports:

A ***report*** is data or information presented in an organized form such as invoices or payroll

checks. One way to classify reports is *by who uses them* an ***internal report*** is used by individuals in the performance of their jobs. For example, a daily sales report that is distributed to sales personnel is an internal report because it is used only by personnel within the organization. An ***external report*** is used outside the organization. Payroll checks that are printed and distributed to employees each week are external reports.

Reports may be classified *by the way they present information*. ***Three*** types of reports are common: ***detail*** reports, ***summary*** reports, and ***exception*** reports.

In a detail report, each line on the report usually corresponds to one input record that has been read and processed. Detail reports contain a great deal of information and can be quite

lengthy. They are usually required by individuals who need access to the day-to-day information that reflects the operating status of the organization. Detail reports contain more information than most managers have time to review.

A summary report summarizes data. It contains totals for certain values found in the input records. The information on the summary report consists of totals from the information contained in the detail report. Summary reports are most useful for individuals who do not require a detailed knowledge of each transaction with a summary report a manager can quickly review information in summarized form.

An exception report consisted information that is outside of "normal" user-specified values or conditions and thus is an "exception" to the

majority of the data. Exception reports help users to focus on situations that may require immediate decisions at specific actions. The advantage of exception reports is that they save time and money.

5.2.2. Graphics:

Other common types of output are computer graphics. In business, computer graphics are often used to assist in analyzing data. Computer graphics display information in the form of charts, graphs, or pictures so that the information can be understood easily and quickly.

The three most popular types of charts and graphs are ***pie charts, bar charts, and line charts.***

5.3 OUTPUT DEVICES:

The two principal kinds of outputs are softcopy and hardcopy as summarized in (Fig 5.1).

Output Devices					
1- Hardcopy				2-Softcopy	
A- Printers		- Plotters	- Computer output microform	A- Display screen	B- Audio Output devices
1- Impact Printers A-dot matrix B- Daisy Wheel C-Line	2-Non-impact Printers A- thermal B-Ink-jet C-Laser				1- Voice Output 2- Music Output

FIGURTE (5-1) Output Devices

5.3.1. Hardcopy Devices:

Hardcopy refers to printed output. Hardcopy output devices are three principal types: ***Printers , Plotters ,and Computer output microform.***

5.3.1.1. Printers:

Printers produce hard-copy output, such as management reports, memos, payroll checks, and program listings. ***Printers*** are generally classified as ***serial printers***, ***line printers***, or ***page printers***. Printers are rated by their print speed. *Print speeds* are measured in *characters per second (CPS)*, for *serial printers*, in *lines per minute (LPM)* for *line printers*, and in *pages per minute (PPM)* for *page printers*.

Printers are further categorized as ***impact*** or ***non-impact***. An *impact printer* uses some type of hammer or hammers to hit the ribbon and the paper, such as a typewriter does. *Non impact printers* use chemicals, lasers, and heat to form the images on the paper.

5.3.1.1.1. Impact Printers:

The term impact refers to the fact that impact printers use some sort of physical contact with the paper to produce an image, physically striking paper, ribbon, and print hammer together. The impact may be produced by a print hammer character, like that of a typewriter key striking a ribbon against the paper, or by a print hammer hitting paper and ribbon against a character as shown in Figure (5-2). ***Dot matrix printers***, ***daisy wheel printers***, and ***line printers*** are types of impact printers.

print.

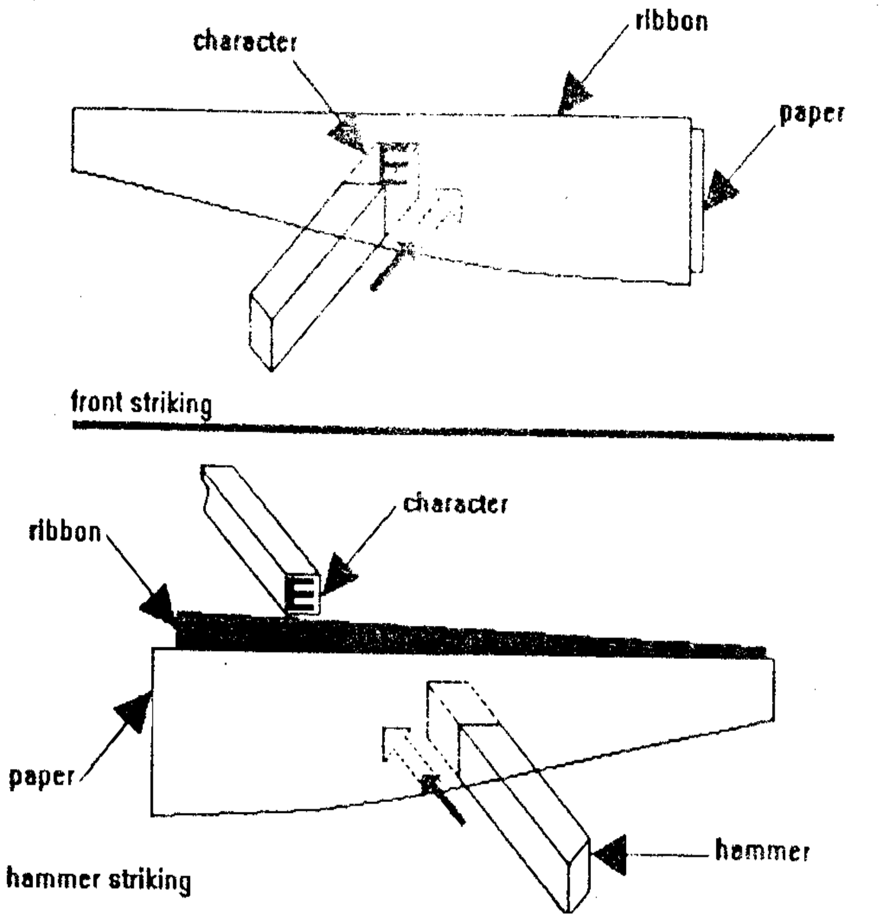


FIGURE (5-2) impact printers

5.3.1.1.1. Dot Matrix Printers:

A dot matrix printer is an impact printer. Its print head consists of a series of small tubes containing pins that, when pressed against a

ribbon and paper, print. It is much like the print mechanism on a typewriter and generally prints one line at a time. Some dot matrix printers can print in multiple colors using ribbons that contain the colors red, green, and blue. They are commonly used in cash registers for receipts, ATM, and many other point-of-sales terminals .The output is of low quality .They are noisy due to the pins striking the ribbon to the paper. They can only print lower-resolution graphics, with limited color performance, limited quality, and lower speeds compared to non- impact printers.

5.3.1.1.1.2. Daisy Wheel Printers:

When users require printed output of high quality, Such as for business or legal correspondence, a letter-quality printer is often used. The term letter quality refers to the quality of

the printed character that is suitable for formal or professional business letters. A letter-quality printed character is a fully formed, solid character like those made by typewriters. It is not made up of a combination of dots, as by a dot matrix printer. Figure(5-3).The disadvantage of a daisy wheel printer is that it is capable of printing only the characters that are on the wheel it cannot, therefore, daisy-wheel printers do not produce graphic images. The daisy wheel print element consists of a number of firms, each with a character at the end when the printer is running the wheel spring unit the desired character is lined up with the hammer. The hammer then strikes against the ribbon and paper, printing the character.

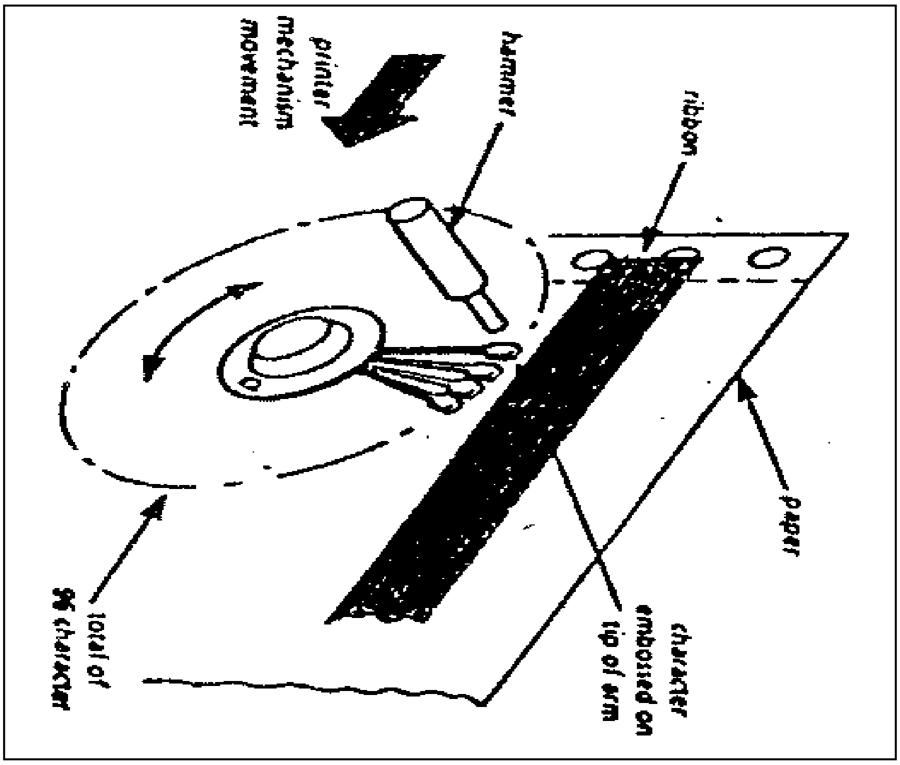


FIGURE (5-3) ***Daisy Wheel Printers***

5.3.1. I.I .3. Line Printers:

Line printers are impact printers that print one line at a time. The most popular types of line printers are the ***band printer*** and ***chain printer***.

Band and chain printers: both band and chain printers have a print hammer for each character position in the line of print (usually 132).

5.3.1.1.2. Non-impact Printers:

A non-impact printer places an image on a page without physically touching the page. The major technologies competing in the non-impact market are ***thermal printers***,***laser printers*** and ***ink-jet printers***.

There are many advantages to non-impact printers over impact ones, but there are two major reasons for their growing popularity: They are *faster and quieter*.

5.3.1.1.2.1. The thermal printers:

The thermal printer is an alternative to the other serial printers. They work similarly to dot matrix printers, heat elements produce dot matrix images on special type of paper (heat-

sensitive paper) called thermo chromic. Thermal printers print faster and quieter than dot matrix printers. They are also smaller, and consume less power, making them ideal for portable and retail applications. The major disadvantage is the cost of the heat-sensitive paper. The advantages include compact size, limited noise, and low purchase price.

5.3.1.1.2.2. Ink-jet Printers:

Ink-jet printer produces letter-quality images by spraying droplets of ink multiple jet nozzles onto the surface of the paper. It can print in both black and white and several different colors of ink to produce excellent graphics. The big *advantage* that ink-jet printers have over impact dot-matrix printers is the quality of the output, especially color output. The main disadvantages of inkjet printers are due to the cost

of ink running and inkjet printer can be more expensive than a laser printer, prints emerge from the printer slightly wet and may need time to dry ,and printing is slower and therefore inkjets aren't designed for high volume printing.

6.3.1.1.2.3. Laser Printers:

Laser printers use a light beam to help transfer images to paper, producing extremely high-quality results. They are the same as photocopiers and multifunction printers. Laser printers print a page at a time impressive speeds. The main advantages of using a laser printer are it is quick at producing high quality images, it is precise and also it is very economical, it has a very low noise output and many off the printers are lightweight and compact so they don’t take up much space on a desk. The main *disadvantages* of using a laser printer are the

cost because cartridges are more expensive than the cost of inkjet printer's toner.

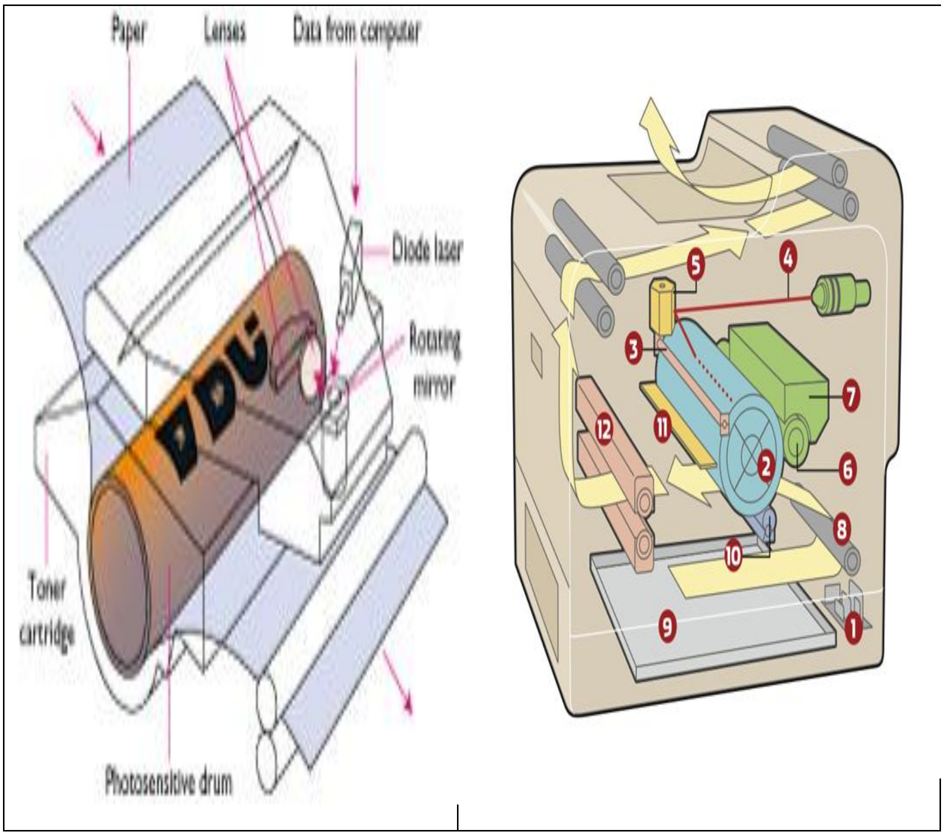


FIGURE (5-4) Laser printer

5.3.1.2. Plotters:

Dot-matrix, ink-jet and thermal printers are capable of producing graphic output, but they are limited in its quality and size. Pen plotters are

devices that convert computer-generated graphs, charts, and line drawings into high-precision hard-copy output. The two basic types of pen plotters are the ***drum plotter*** and the ***flatbed plotter.*** A plotter printer is a computer printing device for printing vector graphics. Plotters print by moving a pen or other instrument across the surface of a piece of paper. The plotters use one or more heads to draw graphics or text and the printer head is attached to a horizontal bar and can be moved horizontally or vertically and draws lines and curves. Pen plotters can draw complex line art including text. Because they are a vector graphics printer, meaning they can only print lines and minimum curves; they are great for printing blueprints and maps. They are very expensive so big businesses are usually the only ones that use them. They are slow because of the mechanical

movement of the pens. They print poor quality ordinary photographs.

5.3.1.3. Computer Output Microform (COM):

COM devices prepare ***microfiche*** that can be read on microform ***viewers***. *Microfiche* is hard-copy output that becomes a permanent record

that can be referenced over and over. Each COM device contains an image to film recorder and a duplicator for making multiple copies of microfiche. The key *advantage* of COM is saved space. This book could be stored on three 4 ×6 inch microfiche.COM is also used extensively instead of hard copy for archival storage. The major *disadvantage* of COM is that it cannot be read without the assistance of special reader device.

5.3.2. Soft Copy Devices:

Soft copy devices refer to data that is shown on a display screen or is in audio - or voice form. This kind of output is *not tangible*, it cannot be touched. Popular types include: ***display screens*** and ***audio output devices***.

5.3.2.1. Display Screens:

A user's first interaction with a computer screen may be to view the screen response to that user's input. When data is entered, it appears on the screen. Furthermore, the computer response to that data-the output-also appears on the screen. The screen is part of the computer's monitor, which also includes the housing for its electrical components.

Computer screens come in many varieties, but the most common kind is the ***<u>Cathode Ray Tube</u>*** (CRT).

A computer display screen that can be used for graphics is divided into ***<u>dots</u>*** that are called ***<u>addressable</u>***, because they can be addressed individually by the graphics software. Each dot can be illuminated individually on the screen. Each dot is potentially a picture element, or

pixel .The *resolution* of the screen— it's clarity-related to the number of pixels on the screen: *The more pixels, the higher the resolution*.

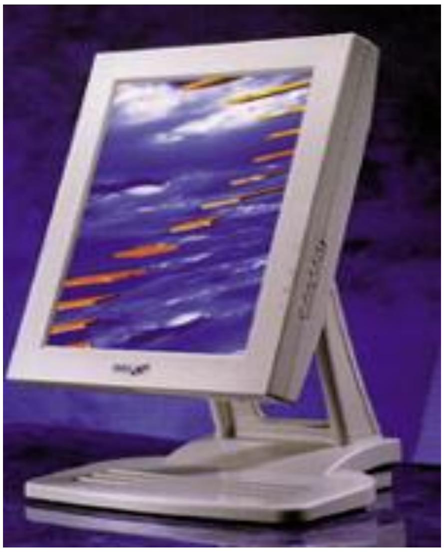
Another factor of importance is dot pitch, the amount of space between the dots. The smaller the dot pitch, the better the quality of the screen image. Most computers come with built-in graphics capability. Others need a device, called a *graphics card* or *graphics adapter board*, which has to be added.

There have been several color screen standards, relating particularly to resolution. The first color display was ***CGA*** (color graphics adapter), which had low resolution by today's standards (320x200 pixels). This was followed by the sharper EGA (enhanced graphics adapter), featuring 640 x350 pixels. VGA(video graphics array) has 640x480 pixel and SVGA (super

VGA) offers 800x600 pixels or 1024x768 pixels are common standards. Today, ***XGA*** (extended graphics array) is a high-resolution graphics standard designed to replace older standards. It provides the same resolutions but supports more simultaneous colors.

5.3.2.1.1. Types of Screens:

Cathode ray tube monitors that display text and graphics are in common use today. Although most CTRs are color, screens are ***monochrome***, meaning only one color, usually green, appears on a dark background. Another type of screen technology is the ***liquid crystal display (LCD)***, a flat display often seen on watches and calculators. LCD screens are used on laptop computers. Some LCDs are monochrome, but color screens are popular. Some laptop screens are nearing CRTs in resolution quality.



5.3.2.1.2. Screens features:

There are <u>*five*</u> features for screens:

- ***Size***
- ***Color***
- ***Cursor***
- ***Scrolling***
- ***Paging***

5.3.2.2. Audio Output devices:

5.3.2.2.1. Voice Output:

There are two basic approaches to getting a computer to talk. The <u>*first*</u> is synthesis by analysis, in which the device analyzes the input of an actual human voice speaking words, stores and processes the spoken sounds, and reproduces them as needed. The <u>*second*</u> approach to synthesizing speech is synthesis by rule, in which the device applies a complex set of linguistic rules to create artificial speech. Synthesis based

on the human voice has the advantage of sounding more natural, but it is limited to the number of words stored in the computer. Voice output has become common in such places as airline and bus terminals, banks, and brokerage houses. It is typically used when an inquiry is followed by a short reply (such as a bank balance or flight time). Many businesses have found other creative uses for voice output as it applies to the telephone. Automatic telephone voice ("Hello, this is a computer speaking...") take surveys, inform customers that catalog orders are ready to be picked up, and perhaps, remind consumers that they have not paid their bills.

5.3.2.2.2. Music Output:

Personal computers can be equipped with speakers placed on either side of the computer or, in some cases, mounted on the sides of the

monitor or buried in the computer housing. Users want good-quality sound from certain kinds of software, especially the sophisticated offerings called *multimedia*, which includes *multiple sight* and *sound effects*. To enhance the listening experience further, manufacturers are now producing *audio chips* that, by varying the frequencies and timing of the sound waves as they reach the human ear, can fool the brain into thinking that it is hearing three-dimensional sound from two speakers.

Chapter (6)
PROCESSING DATA INTO INFORMATION

6.2. Data management.

6.3. Processing stored data.

LEARNING OBJECTIVES :

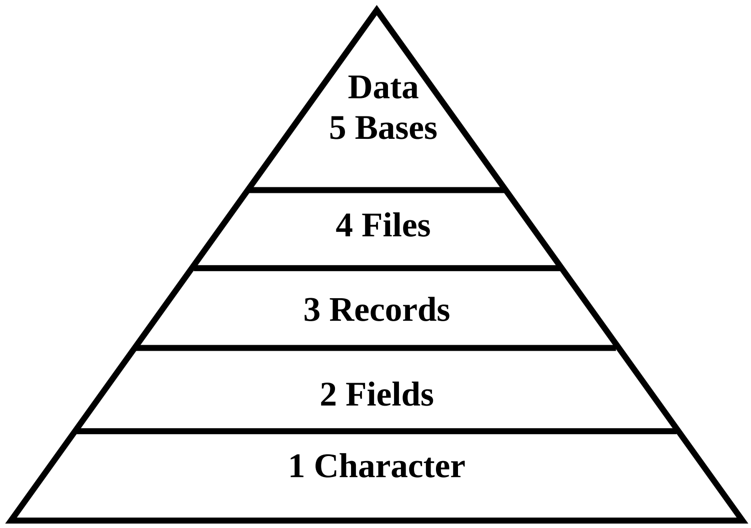
* **Understand how data is organized accessed, and processed.**
* **Become acquainted with three methods of file organization: sequential, direct, and indexed sequential.**
* **Understand the difference between batch and transaction processing.**

6.1.ORGANIZING AND ACCESSING STORED DATA :

Some computer professional-probably a programmer or systems analyst-had to plan how data from users will be received, organized, and stored, and also in what manner data will be processed by the computer. First consider how data is organized for processing.

6.1.1. Data: Getting Organized:

To be processed by the computer, raw data is organized into ***characters, fields, records, files, and databases.***



***A character*: is a letter, digit, or special character** (such as $? or *).

A field*: contains a set of related characters**. A field that contains only ***alphabetic characters, such as the name field containing ***AHEAD***, is called an alphabetic field. A field that contains ***numeric characters*** is called a numeric field. Numeric field may also contain some special characters that are commonly used with numbers, such as a decimal point (.) and the plus (+) and

minus (-) signs. Even with the plus sign (+) and decimal point (.) the number + 500.00 is still called a numeric field. Fields that contain a combination of character types, such as the data 01/31 (numeric and special characters), are called ***alphanumeric fields***.

<u>A record</u>: is a collection of related fields. Thus, For example, one person's number, name, address, city, and phone number constitute a record.

<u>A file</u>: is a collection of relation of related records.

<u>A database</u>: is a collection of interrelated files stored together with minimum redundancy.

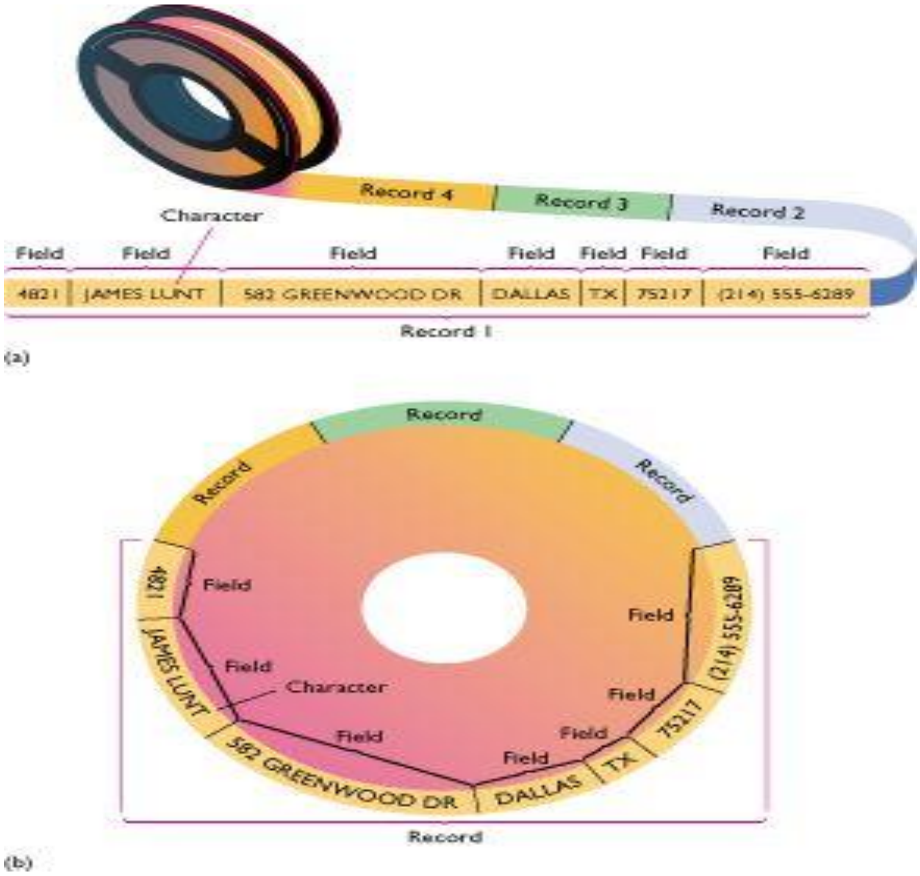


FIGURE (6-1) How data is organized

6.1.2. The File plan: An Overview:

Now that we have a general idea of how data is organized, we need to consider what way would be appropriate to place data on a storage

medium-tape or disk. Consider this chain: (1) it is the application-payroll, airline reservations, inventory control, whatever-that determines the way the data must be accessed by users. (2) Once an access method has been determined, then it follows that there are certain ways the data must be organized so that the needed access is workable. (3) The organization method, in turn, limits what storage medium may be used. We will discuss both ***organization*** and ***access*** in detail.

6.1.3. File Organization: Three Methods:

There are ***three*** major methods of storing files of data in *secondary storage*:

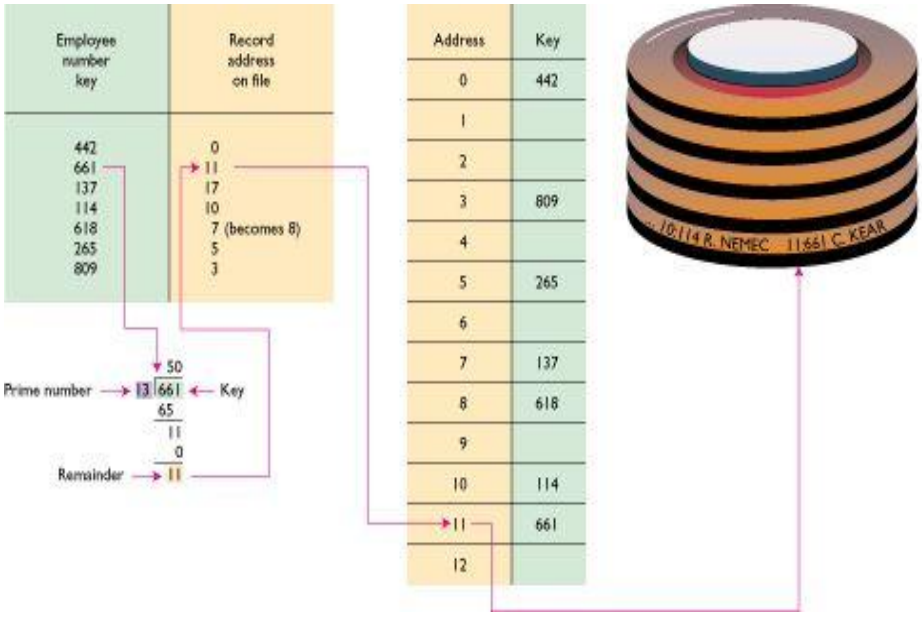
6.1.3.1. *Sequential File Organization*:

Sequential file processing means records are in order according to a **key field**. If a particular record in a sequential file is wanted, then all the

prior records in the file must be read before reaching the desired record. Tape storage is limited to sequential file organization. Disk storage may be sequential, but records on disk also be accessed directly.

6.1.3.2. ***Direct File Organization***:

Direct file processing, or direct access, allows the computer to go directly to the desired recorded by using a record key; the computer does not have to read all precede records in the file as it does if the records are arranged sequentially. Direct processing requires disk storage; in fact, a disk device is called a Direct-Access Storage Device (DASD) because the computer can go directly to the desired record on the disk. An added benefit of direct access organization is the ability to read, change, and returns a record to its same place on the disk; this is called ***updating*** in place.



6.1.3.3. ***<u>Indexed File Organization</u>***:

It represents a compromise between the sequential and direct methods, which records are organized ***sequentially***, but indexes built into the file allow a record to be accessed either ***sequentially*** or ***directly***. It is useful in applications where a file needs to be in sequential order but, in addition, access to individual records is needed.

6.1.4. Disk Access to Data:

Three primary factors determine ***access time***, *the time needed to access data directly on disk:*

****Seek time:*** This is the time it takes the access arm to get into position over a particular track.

****Head switching***: Head switching is the activation of a particular read/write head over a particular track on a particular surface.

****Rotational delay:*** Once the access arm and read/write head is in position, ready to read or write data, the read/write head waits for a short period until the desired data on the track moves under it. One measure for the performance of disk drives is the average access time, which is usually measured in ***milliseconds*** (ms). Another measure is the data transfer rate, which tells how fast data can be transferred once it has been

found. This usually will be stated in terms of ***megabytes*** of data per second.

6.2. DATA MANAGEMENT:

For data to be useful in the processing cycle, it must have certain attributes such as accuracy. Data management refers to ***techniques***, ***methods***, and ***procedures*** that are used to manage these attributes and provide for the security and maintenance of data. The purpose of data management is to ensure that data required for an application will be available in the correct form and at the proper time for processing.

6.2.1. Data Attributes:

One attribute of data is that it must be available. Another important attribute of data in this application or any other is its ***integrity***. Data integrity affects the confidence a user has in

processing that data. *The <u>three</u> primary elements of data <u>integrity</u> are:*

(1) Data accuracy.

(2) Reliable data entry.

(3) Timeliness.

Data integrity is critical. Before an application is implemented on a computer, all the criteria for valid data must be defined and checks for valid data should be placed in the programs.

6.2.2. Data Security:

Data management also includes managing data security. ***Data security*** refers to protecting data to keep it from being misused or lost. With any method of data storage, a ***<u>backup</u>*** system-a *<u>way of storing data in more than one place to protect it from damage and errors</u>*-is vital. For personal computer users, an easy and inexpensive

way to back up a hard disk file is to simply copy it to a diskette whenever it is updated.

6.2.3. Data Maintenance:

Data maintenance, another aspect of data management, refers to the procedures used to maintain data accuracy by keeping data current. These procedures are called ***updating*** and include *adding new data*, such as creating a record for a new person to include in the credit bureau database; *changing existing information*, such as posting a change of address to an existing record; and *deleting obsolete information*, such as removing inactive records after some designated period of time.

6.2.4. Types of Files:

Data files can be classified into different types by ***the application used for***, by t***heir stored***

data permanence, and by ***their stored data accessing***.

4.2.4.1. Files are frequently classified by the application for which they are primarily used, such as a "*payroll file*" an "*inventory file*", or an "*accounts receivable file*".

6.2.4.2. Files are also classified by their ***permanence*** (*the amount of time that data need to be stored in*) as a "*transaction file*" and "a *mater file".* A "transaction file" contains records of transactions occurring during a period that are data to be retained only until it is time to process. Thus, a transaction file is a data file of ***temporary*** or relatively transient data to be processed, such as a "payroll-weekly transaction file", or an "inventory-daily transaction file". A "master file" contains records of ***semi-permanent*** data to be retrieved and updated periodically during

processing such as a "payroll master file", or an "inventory master file".

6.2.4.3. Files are also classified according to the method by which the stored data can be ***accessed*** into two major types, as "*sequential files*" and *"direct-access files".* In ***sequential files***, all records are kept in some sequence; such as in order by employee code number, inventory item number, or customer number. The most common storage medium for sequential files is the *magnetic tape*. The most common storage medium for ***direct-access*** files is the *magnetic disk*. The desired record in the file can be reached immediately. Records on disk may be placed in a random manner that is no particular order.

6.3. PROCESSING STORED DATA :

There are several methods of processing data files in a computer system. The ***two*** main

methods are: (1) ***Batch processing*** (processing data in groups at a more convenient later time and also called *off-line* processing or *sequential* processing), and (2) ***Real-time processing*** (processing data immediately, as it is received and also called *on-line* processing or *direct processing*).

6.3.1 Batch processing: Do It Later:

In batch processing, transactions data are accumulated over a period of time and processed periodically. Batch processing usually involves the following activities:

1. Gathering source documents originated by business transactions, such as sales orders, and invoices, into groups called batches.
2. Recording transaction data on some type of input medium, such as magnetic disk or magnetic tape.

3. Sorting the transactions in a transaction file in the same sequence as the records in a sequential master file.
4. Processing transaction data and creating an updating master file and a variety of documents (such as customer invoices and paychecks and reports).

In an example of batch processing, the ***banking*** business usually accumulates all checks deposited during the day into batches for processing each evening. Thus, customer bank balances are updated on a daily basis and many management reports are produced daily.

<u>Batch processing is an economical method</u> *<u>when large volumes of transactions data must be processed.</u>* For example, customer statements may be prepared on a monthly basis, whereas

payroll processing may be done on a weekly basis.

However, batch processing has some *disadvantages*. *Master files* are frequently *out-of-date* between scheduled processing, as are the periodic reports that are produced. Also *immediate responses to inquiries cannot be made*. However, batch processing systems are still widely used, and some of their disadvantages are overcome by using real-time processing for some transaction processing functions, such as data entry or inquiry processing. Figure : (6-4)

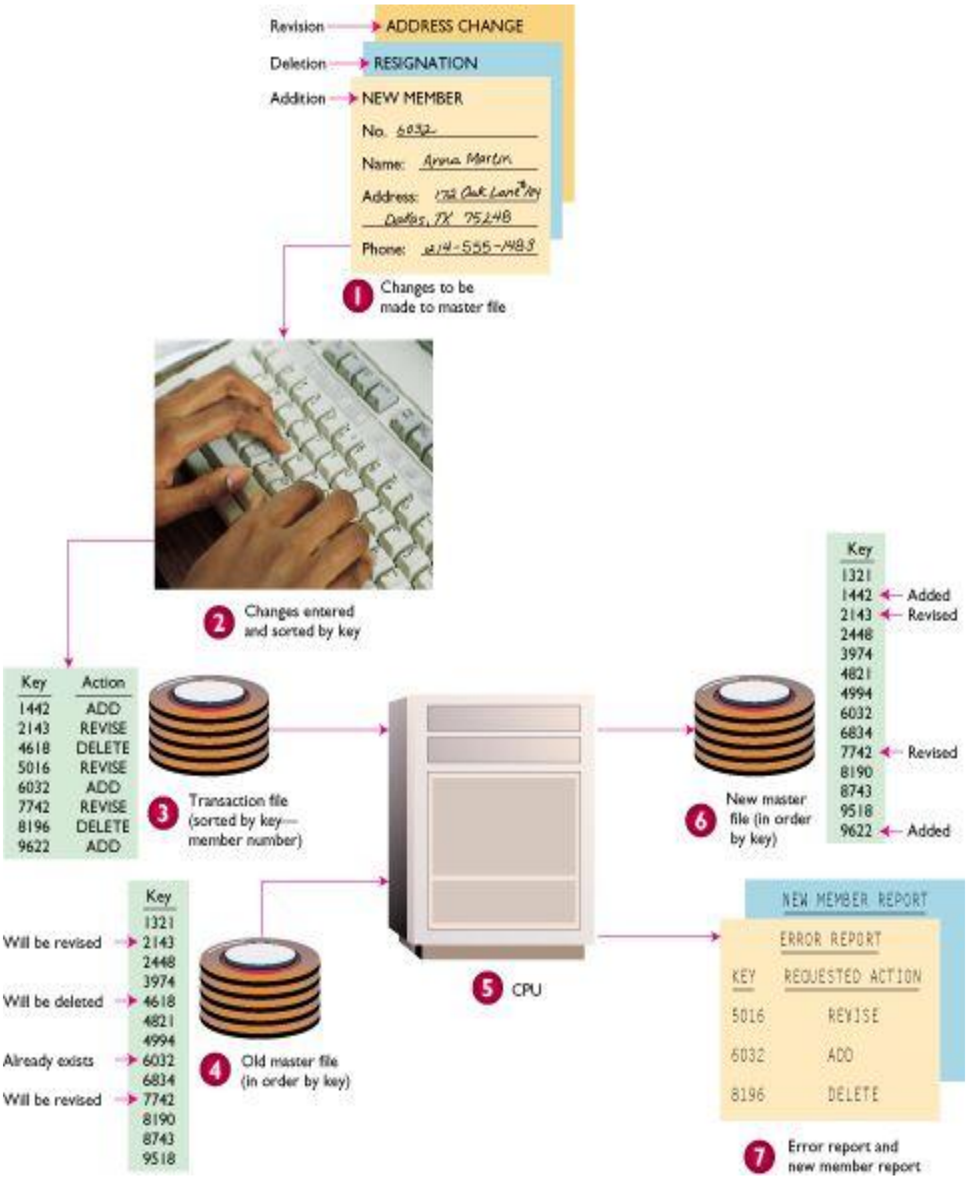


FIGURE (6-4) How batch processing works.

6.3.2 Real-time Processing: Do It Now

Real-time processing allows transaction data to be processed *immediately* after they are generated and can provide immediate output to end users. Transactions data are processed as soon as they are originated or recorded without waiting to accumulate batches of data. Data is fed directly into the computer system from on-line terminals, without being sorted, and they are always stored in ***on line*** direct access files.

Files and data bases are always *up to date* since they are updated whenever data is originated, regardless of their frequency. Responses to end user’s inquiries are immediate, since information stored on direct access devices can be retrieved almost instantly.

As an example of a real – time *sales transaction processing system*, *POS terminals* are

connected to a computer for immediate entry of sales data and immediate responses.

Real-time processing provides immediate updating of files and immediate responses to user inquiries. ***Real-time processing is a costly method***. Figure: (6-5)

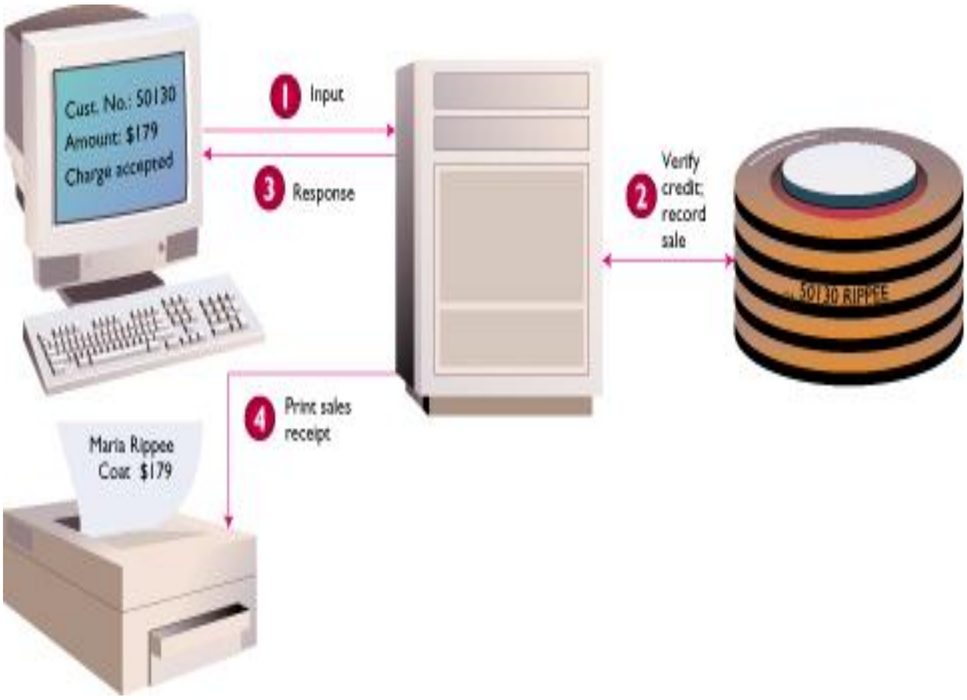


Figure (6-5) how transaction processing works

6.3.3. Batch and Transaction Processing: The Best of Both Worlds:

Numerous computer systems combine the best features of both methods of processing. Generally speaking, transaction processing is used for activities related to the current needs of people--especially workers and customers--as they go about their daily lives. Batch processing; by comparison, can be done at any time, even in the middle of the night, without worrying about the convenience of the people ultimately affected by the processing.

	Batch processing	*Transaction Processing*
lvantages	1-Requires less complex and expensive hardware and software	1- Provides up-to-data information in a timely manner.
	2-Normally employs more efficient sequential processing mode.	Provide early and thorough validation of data to assure accuracy and completeness.

	3-Provide added control through such mechanisms as batch totals	Eliminates storing and transcribing of data
		Provides added flexibility to changing needs of users.
Disadvantages		
	Allows records in master files to become out of-data	1- Requires more complex and expensive hard ware and soft ware.
	Inhibits the timely retrieval of data from records (when magnetic tape are used).	Inhibits use of batch totals for control.
	Normally requires storing and transcribing activities.	Employs less efficient random processing method.
	4-Requires more manual handling of files, programs, and source documents. (especially when magnetic tape storage is used).	

Table (6.1)

compares the relative advantages of these two choices

Chapter (7)
NETWORKING COMPUTER CONNECTIONS

7.1. Data communications.

7.2. Putting together a network.

7.3. Data transmission.

7.4. Network topologies.

7.5. Wide area networks.

7.6. Local area networks.

7.7. The work of networking.

7.8. The Internet.

LEARNING OBJECTIVES **:**

- **Become acquainted with the evolution of data communications systems, from centralized processing to teleprocessing to distributed data processing to local area networks.**
- **Know the basic components of a data communications system.**
- **Know data transmission methods, including types of signals, modulation, and choices among transmission modes.**
- **Differentiate the various kinds of communications links, and appreciate the need for protocols.**
- **Understand network configurations.**
- **Know the components, types and protocols of a local area network.**

- **Appreciate the complexity of networking.**
- **Become acquainted with examples of networking.**
- **Appreciate the importance of the Internet.**

7.1. DATA COMMUNICATIONS :

How it all began:

Mail, telephone, TV and radio, books, newspapers, and periodicals these are the principal ways we send and receive information, and they have not changed appreciably in a generation. However, ***data communications systems*** computer systems that transmit data over communications lines such as telephone lines or cables have been gradually evolving since the mid 1960s. Let us take a look at how they came about.

In the early days of computing, ***centralized data processing*** placed everything all processing, hardware, and software in one central location. Computer manufacturers responded to this trend by building even larger, general purpose computers so that all departments within an

organization could be serviced. Eventually All input data had to be physically transported to the computer, and all processed material had to be picked up and delivered to the users. Insisting on centralized data processing was like insisting that all conversations between people occur face-to-face in one designated room.

The next logical step was ***teleprocessing systems*** terminals connected to the central computer via communications lines. ***Teleprocessing systems*** permitted users to have remote access to the central computer from their terminals in other buildings and even other cities. However, even though access to the computer system was ***decentralized***, all processing was still centralized that is, performed by a company's one central computer.

In the 1970s businesses began to use minicomputers, which were often at a distance from the central computers. These were clearly ***decentralized*** systems because the smaller computers could do some processing on their own, yet some also had access to the central computer. This new setup was labeled ***distributed data processing (DDP)***. It is similar to teleprocessing, *except* that it accommodates *not only remote access but also remote processing*. A typical application of a distributed data processing system is a business or organization with many locations perhaps branch offices or retail outlets.

The whole picture of distributed data processing has changed dramatically with the advent of networks of personal computers. By network we mean a computer system that uses

communications equipment to connect two or more computers and their resources. ***DDP*** systems are networks. But of particular interest in today's business world are ***Local Area Networks (LANs)***, which are designed to share data and resources among several individual computer users, in an office or building (Figure 7-1).

(Figure7- 1) Local area network. Although allocated to individual workers, the computers shown here are wired together so that their users can communicate with one another.

7.2. PUTTING TOGETHER A NETWORK :

Even though the components needed to transmit data from one computer to another seem quite basic, the business of putting together a network can be extremely complex. We begin with the initial components and then move to the list of factors that a network designer would have to consider.

7.2.1. Getting Started:

The basic configuration how the components are put together is pretty straightforward, but there is a great variety of components to choose from, and the technology is ever changing. Assume that you have some data message to transmit from one place to another.

The basic components of a data communications system used to transmit that message are:

(1) a sending device,

(2) a communications link, and

(3) a receiving device.

There is another often-needed component that must be mentioned in this basic configuration, as you can see in (Figure 7-2). This component is a ***MODEM***, which is usually needed to convert computer data to signals that can be carried by the communications channel and vice versa.

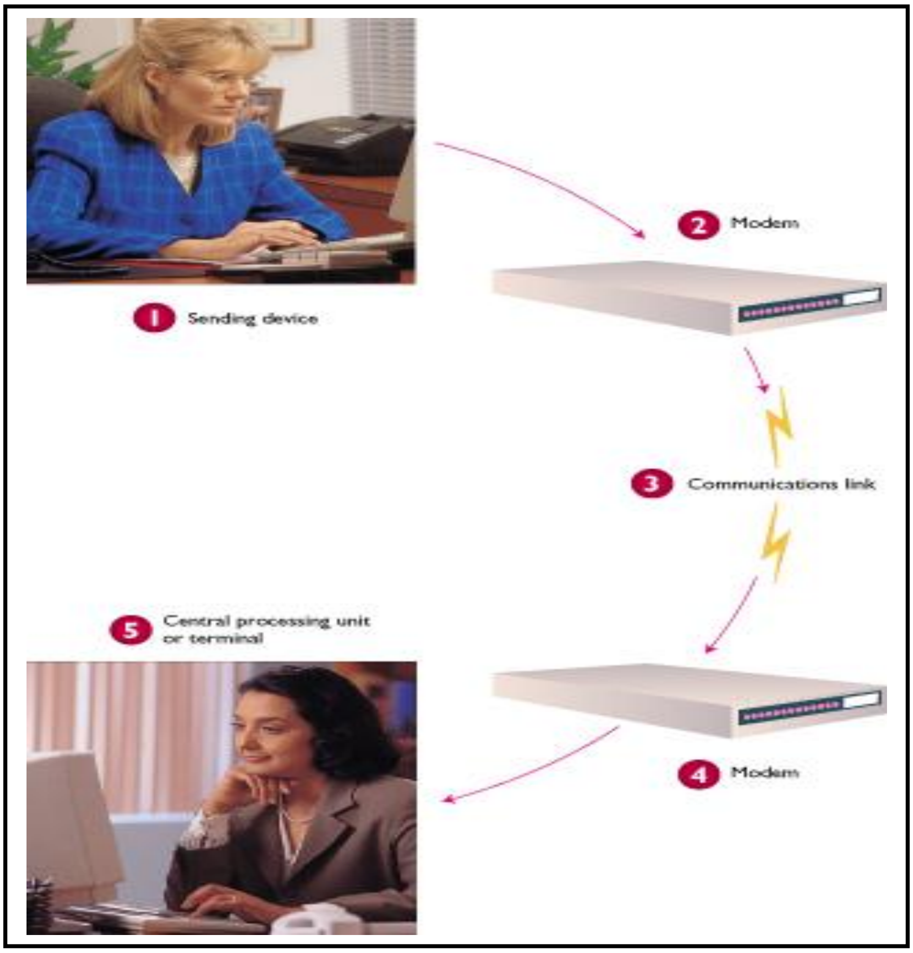


Figure 7-2 Communications system components.

Data originated from (1) a sending device is (2) converted by a modem to data that can be carried over (3) a communications link and (4) reconverted by a modem at the receiving end before (5) being received by the destination computer.

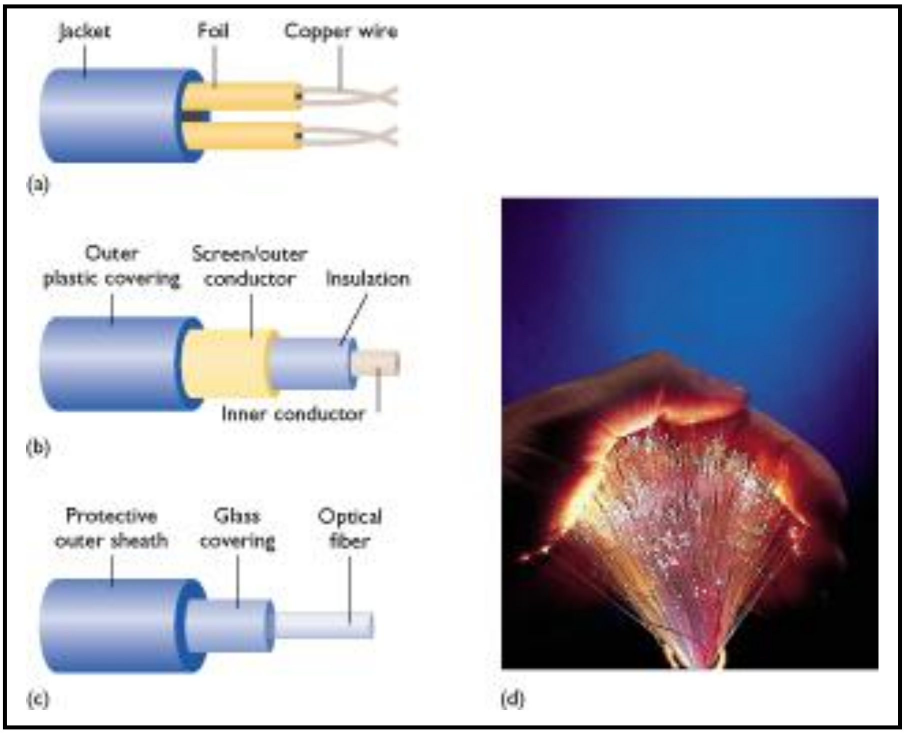
Large computer systems may have additional components. At the computer end, data may travel through a communications control unit called a ***front-end processor***, which is actually a computer in itself. Its purpose is to relive the central computer of some of the communications tasks and thus free it for processing applications programs. In addition, a front-end processor usually performs error detection and recovery functions.

7.2.2. Network Design Considerations

The tasks of network design are a complex one, usually requiring the services of a professional specifically trained in that capacity. In order for two or more computers to communicate, *specialized hardware* is required. ***First***, the multiple computers must be connected together through *transmission media* over which the data are transmitted. ***Second***, there must be communication processors that put the data in a form that can be transmitted through the

transmission media and convert the received signals into a form the computers can use. ***Transmission media*** can either be ***physical*** or ***wireless***. The ***three*** most common types of ***physical transmission media*** are, ***Twisted-pair cable, Coaxial cable, and Fiber optic cable.*** *Twisted-pair cable (Wire Pairs) is* the type of wiring used in telephone systems, and transmits data as electric signals. This is the least expensive media but is the most prone to interference that can distort the signal. *Coaxial cable*, the type used in cable TV systems, is less likely to distort the signal being transmitted, but is more expensive. Data is transmitted in electric form. *Fiber optic* cable transmits a signal in the form of light. Fiber optic technology is much faster, can transmit data at higher rates, and is less prone to interference. However, it is not widely available and is more expensive. The ***two*** most common types of

wireless media are ***radio signals and microwave signals.***



Communications links. (a) Wire pairs are pairs of wires twisted together to form a cable, which is then insulated. (b) A coaxial cable is a single conductor wire surrounded by insulation. (c) Fiber optics consists of hairlike glass fibers that carry voice, television, and data signals. (d) This photo shows light emitted from a handful of fiber optic cables.

7.3. *DATA TRANSMISSION*

A terminal or computer produces ***digital signals***, which are simply the presence or absence of an electric pulse. The state of being *on* or *off* represents the binary number *1* or *0*, respectively. Some communications lines accept digital transmission directly, and the trend in the communications industry is toward digital signals. However, most telephone lines through which these digital signals are sent were originally built for voice transmission, and voice transmission requires analog signals.

7.3.1. Digital and Analog Transmission

Digital transmission sends data as distinct pulses, either on or off, in much the same way that data travels through the computer. However, most communications media are not digital. Communications devices such as telephone lines,

coaxial cables, and microwave circuits are already in place for voice transmission. The easiest choice for most users is to piggyback on one of these. Thus, the most common communications devices all use analog transmission, a continuous electric signal in the form of a wave.

To be sent over analog lines, a digital signal must first be converted to an analog form. It is converted by altering an analog signal, called a *carrier wave*, which has alterable characteristics (Figure 7-3a). One such characteristic is the *amplitude*, or height of the wave, which can be increased to represent the binary number 1 (Figure 7-3b). Another characteristic that can be altered is the *frequency*, or number of times a wave repeats during a specific time interval, frequency can be increased to represent a 1 (figure 7-3c).

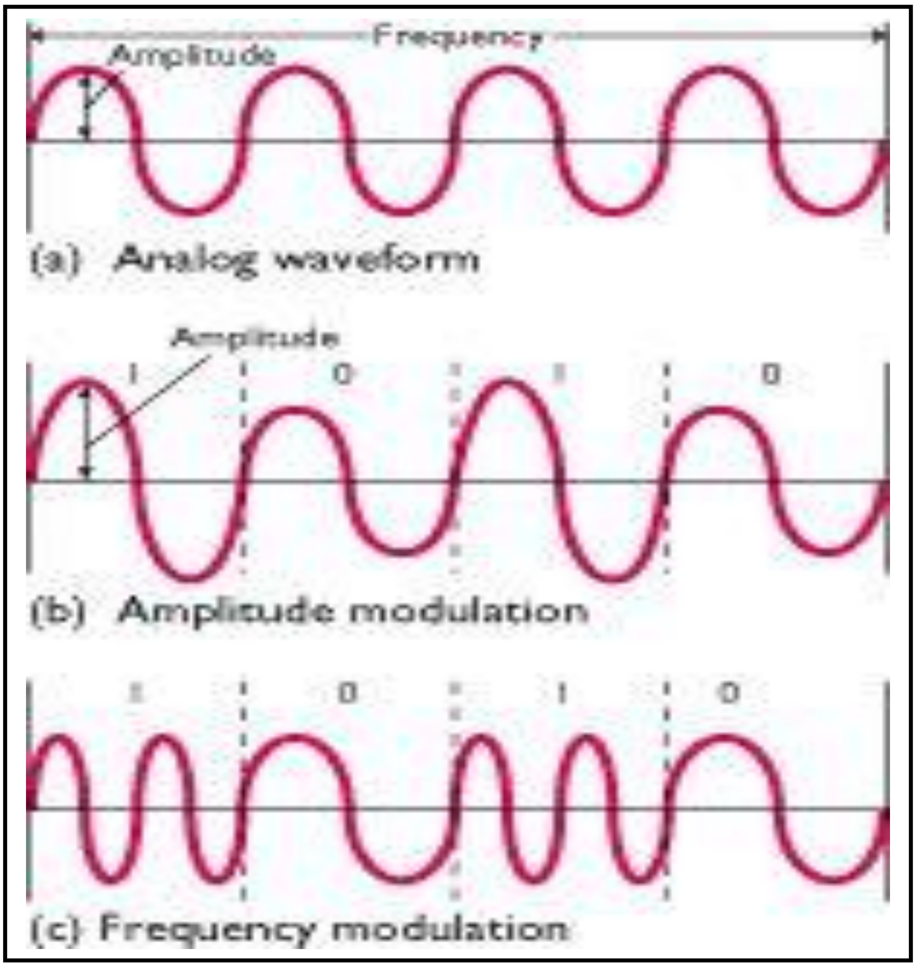


Figure 7-3 Analog Signals. (a) An analog carrier wave moves up and down in a continuous cycle. (b) The analog waveform can be converted to digital form through amplitude modulation. As shown, the wave height is increased to represent a 1 or left the same to represent a zero. (c) in frequency modulation the amplitude of the wave stays the same but the frequency increases to indicate a 1 or stays the same to indicate a zero.

Conversion from digital to analog signals is called ***modulation***, and the reverse process reconstructing the original digital message at the other end of the transmission is called ***demodulation***. An extra device is needed to make the conversions: a ***MODEM***.

7.3.2. Modems

A *modem* is a device that converts a digital signal to an analog signal and vice versa. A *modem* is a device that is used to attach your computer to the telephone system. The modem converts data into sound that is sent over the telephone line, the receiving modem turns the sounds back into data. (Figure 7-4). *MODEM* is short for ***MOdulate/ DEModulate***.

7.3.2.1. Types of modems

Modems vary in the way they connect to the telephone line. There are ***two*** main types: ***acoustic coupler modems and direct-connect modems***. A*coustic coupler* modems include a cradle to hold the telephone handset. Most modems today, however, are directly connected to the phone system.

A *direct-connect modem* is directly connected to the telephone line by means of a telephone jack. An *external modem* is separate from the computer (Figure 7-4). Its main *advantage* is that it can be used with a variety of computers. If you buy a new personal computer, for example, you can probably keep the same external modem. For a modem that is out of sight literally an *internal modem* board can be inserted into the computer

by the user, it might even come installed in a personal computer as standard equipment.

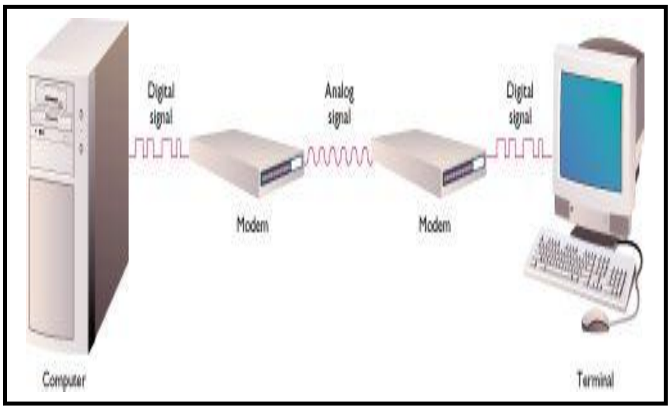


Figure 7-4 modems. Modems convert----modulate---digital data signals to analog signals for traveling over communications links, then reverse---demodulate—at the other end.

7.3.2.2. Modem Data Speeds

Users who connect their computers via communications services may pay charges based on the time the computers are connected. Thus, there is a strong incentive to transmit as quickly as possible. The old standard modem speeds of 9600, 14400, and 28800 *bits per second* (*bps*) have now been superseded by modems rated at 56 Kilobits per second (Kb/sec). The speed sters using these rates are usually corporations sending data from one office to another. Communication via phone lines requires a modem to convert between the computer's digital signals and the analog signals used by phone lines. One technology is called ***Integrated Services Digital Network,(ISDN).*** The attraction is that an *ISDN* adapter can move data at 128,000 bps, a vast

speed improvement over any modem. Another *advantage* is that an *ISDN* circuit includes two phone lines, so a user can use one line to connect to the Internet and the other to talk on the phone at the same time.

7.4. NETWORK TOPOLOGIES

A network is a computer system that used communications equipment to connect computers. They can be connected in different ways. The physical layout of a network is called a ***topology***. There are *three* common topologies: ***star, ring, and bus*** network topology, we often refer to a ***node***, which is a computer on a network. (The term ***node*** is also used to refer to any device connected to a network, including the server, computers, and peripheral devices such as printers.)

A star network has a *hub* computer that is responsible for managing the network (Figure 7-4a). All messages are routed through the central computer, which acts as a traffic cop to prevent collisions. Any connection failure between a node and the hub will not affect the overall system. However, if the hub computer fails, the network fails.

A ring network links all nodes together in a circular chain (Figure 7-4b). Date messages travel in only one direction around the ring. Any data that passes by is examined by the node to see if it is the addressee, if not, the data is passed on to the next node in the ring. Since data travels in only one direction, there is no danger of data collision. However, if one node fails, then the entire network fails.

A bus network has a single line to which all the network nodes are attached (Figure 7-4c). Computers on the network transmit data in the hope that it will not collide with data transmitted by other nodes, if this happens, the sending node simply tries again. Nodes can be attached to or detached from the network without affecting the network. Furthermore, if one node fails, it does not affect the rest of the rest of the network.

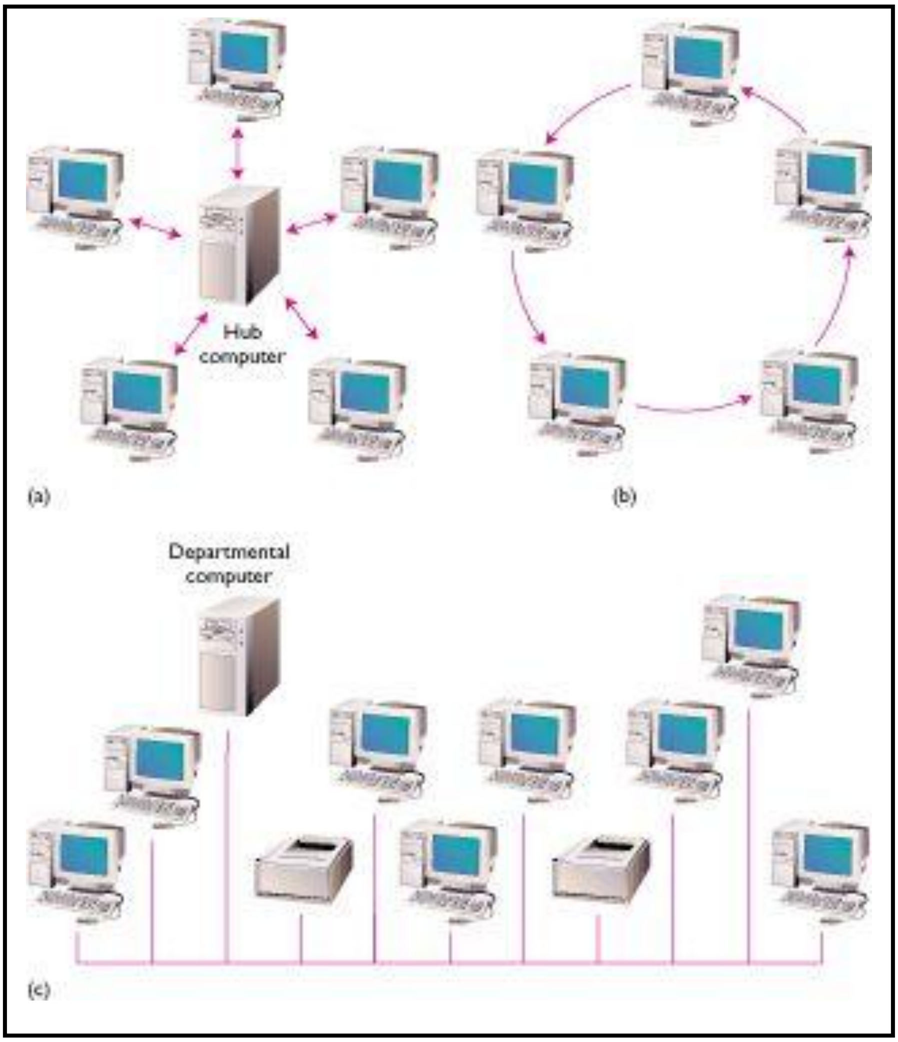


Figure 7-4Topologies. (a) The star network topology has a central computer that runs the network. (b) The ring network topology connects computers in a circular fashion. (c) the bus network topology connects all nodes in a line and can preserve the network if one computer fails.

7.5. WIDE AREA NETWORKS

There are different kinds of networks. We begin with the geographically largest, a wide area network.

A *Wide Area Network (WAN)* is a network of ***geographically distant*** computers and terminals. In business, a personal computer sending data any significant distance is probably sending it to a minicomputer or mainframe computer. Since these larger computers are designed to be accessed by terminals, a personal computer can communicate with a minicomputer or mainframe only if the personal computer emulates, or imitates, a terminal. This is accomplished by using *terminal emulation software* on the personal computer. The larger computer then considers the personal computer or

workstation as just another user input/output communications device a terminal.

When smaller computers are connected to larger computers, the result is sometimes referred to as a micro-to-mainframe link. The larger computer to which the terminal or personal computer is attached is called the ***host computer***. If a personal computer is being used as a terminal, *file transfer software* permits users to ***download*** data files from the host or ***upload*** data files to the host. To *download* a file means to retrieve it from another computer. To *upload*, a user sends a file to another computer.

7.6. LOCAL AREA NETWORK

A ***local area network (LAN)*** is a collection of computers, usually personal computers that share hardware, software, and data. In simple terms, *LANs* hook personal computers together

through communications media so that each personal computer can share the resources of the others. As the name implies, LANs cover ***short distances***, usually *one office or building or a group of buildings that are close together.*

7.6.1. Local Area Network Components

LANs do not use the telephone network. Networks that are LANs are made up of a standard set of components.

- All networks need some system for interconnection. In some LANs the *nodes* are connected by a shared *network cable*. Low-cost LANs are connected with twisted wire pairs, but many LANs use coaxial cable or fiber optic cable, which are both more expensive and faster. Some local area networks, however, are wireless, using infrared or radio wave transmissions instead

of cables. Wireless networks are easy to set up and reconfigure, since there are no cables to connect or disconnect, but they have slower transmission rates and limit the distance between nodes.

- A ***Network-Interface Card***, sometimes called a ***NIC***, connects each computer to the wiring to the network. A ***NIC*** is a circuit board that fits in one of the computers internal expansion slots. The card contains circuitry that handles sending, receiving, and error checking of transmitted data.
- Similar networks can be connected by a ***bridge***, which recognizes the message on a network and passes on those addressed to nodes in other networks. For example, a fabric designer whose computer is part of a department LAN for a textile manufacturer

could send cost data, via a bridge, to someone in the accounting department whose computer is part of another company LAN, one used for financial matters.

A ***Router*** *is a special computer that directs communications traffic when several networks are connected together.* If traffic is clogged on one path, the *router* can determine an alternative path. More recently, now that many networks have adopted the ***Internet protocol (IP)***, routers are being replaced with *IP switches*, which are less expensive and, since no translation is needed, faster than routers.

- A ***Gateway*** *is a collection of hardware and software resources that lets a node communicate with a computer on another dissimilar network.* A *gateway*, for example,

could connect an attorney on a local area network to a legal service offered through a wide area network.

7.6.2. Local Area Network Types

Two ways to organize the resources of a LAN are ***client/server and peer-to-peer***.

Client/Server

A ***client/server*** arrangement involves a ***server***, which is a computer that controls the network. In particular, a *server* has the hard disks holding shared files and often has the highest-quality printer, which can be used by all nodes (Figure 7-5). The clients are all the other computers on the network. Under the client/server arrangement, processing is usually done by the server, and only the results are sent to the node. Sometimes the server and the node, share processing. Client/server has attracted a lot

of attention because a well-designed system reduces the volume of data traffic on the network and allows faster response at each node. Also, since the server does most of the heavy work, less expensive computers can be used as nodes.

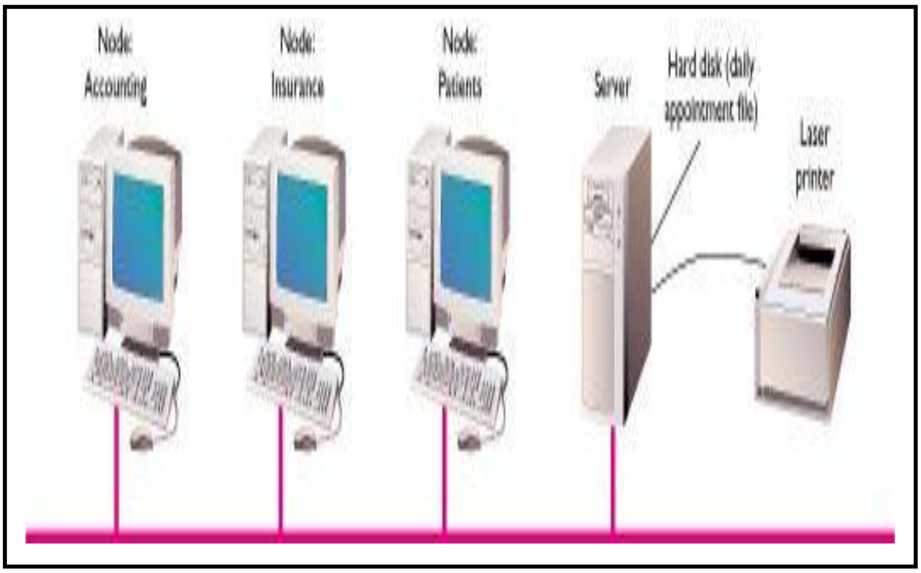


Figure 7-5 Server and peripheral hardware. In this network for a clinic with seven doctors, the daily appointment records for patients are kept on the hard disk associated with the server. Workers who, using their own computers, deal with accounting, insurance, and patient records can access the daily appointment file to update their own files.

Peer-To-Peer

All computers in a ***peer-to-peer*** arrangement have equal status; no one computer is in control. With all files and peripheral devices distributed across several computers, users share each other's data and devices as needed. Peer-to-peer networks are common in small offices with perhaps a dozen personal computers. An example might involve a corporate building in which marketing wants its files kept on its own computer, public relations wants its files kept on its own computer, personnel wants its files kept on its own computer, and so on; all can still gain access to the other's files when needed. The main *disadvantage* is lack of speed most peer to peer networks slow down under heavy use. Many networks are hybrids, containing elements of client/ server and peer to peer arrangements.

7.7. THE WORK OF NETWORKING :

Think of the millions of telephones installed throughout the world; theoretically, you can call any one of them. Further, every one of these phones has the potential to be part of a networking system. Although we have discussed other communications media, it is still the telephone that is the basis for action for the user at home or in the office. Revolutionary changes are in full swing in both places, but particularly in the office.

The use of automation in the office is as varied as the offices themselves. As a general definition, office automation is the use of technology to help people do their jobs better and faster. Much automated office innovation is based on communications technology. The several important office technology topics are

<u>electronic mail, voice mail, facsimile technology, teleconferencing, electronic data interchange, and electronic fund transfers.</u>

7.7.1. Electronic Mail :

<u>Electronic Mail, or E-Mail</u>*, is the process of sending messages directly from one computer to another*. Electronic mail works, of course, only if the intended receiver has the electronic mail facility to which the sender is connected. *There are several electronic mail options*. ***One*** option is for a user to enlist a third party service bureau that provides electronic mail service for its customers. ***Another*** option is to use a public data network such as the Internet.

<u>Electronic mail</u> can reach many people with the same message, reduce the paper flood, and does not interrupt meetings the way a ringing phone does. Since e-mail does not require both

participants to be present at the time of transmission, it is a boon to people who work on the same project but live in different time zones. Furthermore, with software called *smart e-mail*, e-mail's role is being broadened to display screen messages, schedule meetings, and even file expense reports.

7.7.2. Voice Mail:

Voicemail systems *are designed to convey a caller's recorded audio message to a recipient.* Simple voicemail systems function as a remote answering machine using touch-tones as the user interface. If the person being called does not answer, the caller is given instructions to dictate a message to the system. The voice mail computer system stores the message in the recipient's "*voice mailbox*". Later, when the recipient dials the mailbox, the system delivers the message. A

voice mail system *translates the word of a message into digital impulses, which it then stores on disk, just as any other data. Later, the stored message is reconverted to audio form* (Figure 7-6). Voice mail also may sound like a spoken version of electronic mail. There is one big difference between electronic mail and voice mail, however. To use electronic mail, you and the mail recipient must have compatible devices with a keyboard and be able to use them. In contrast, telephones are everywhere and everyone already knows how to use them.

More complicated systems may use other input devices such as voice or a computer interface. More advanced systems may be integrated with a company's ***PABX***, with a call center *ACD* for *Automatic Call Distribution*; with mobile or paging terminals for message alert; and

computer systems/data bases for delivering information or processing orders.

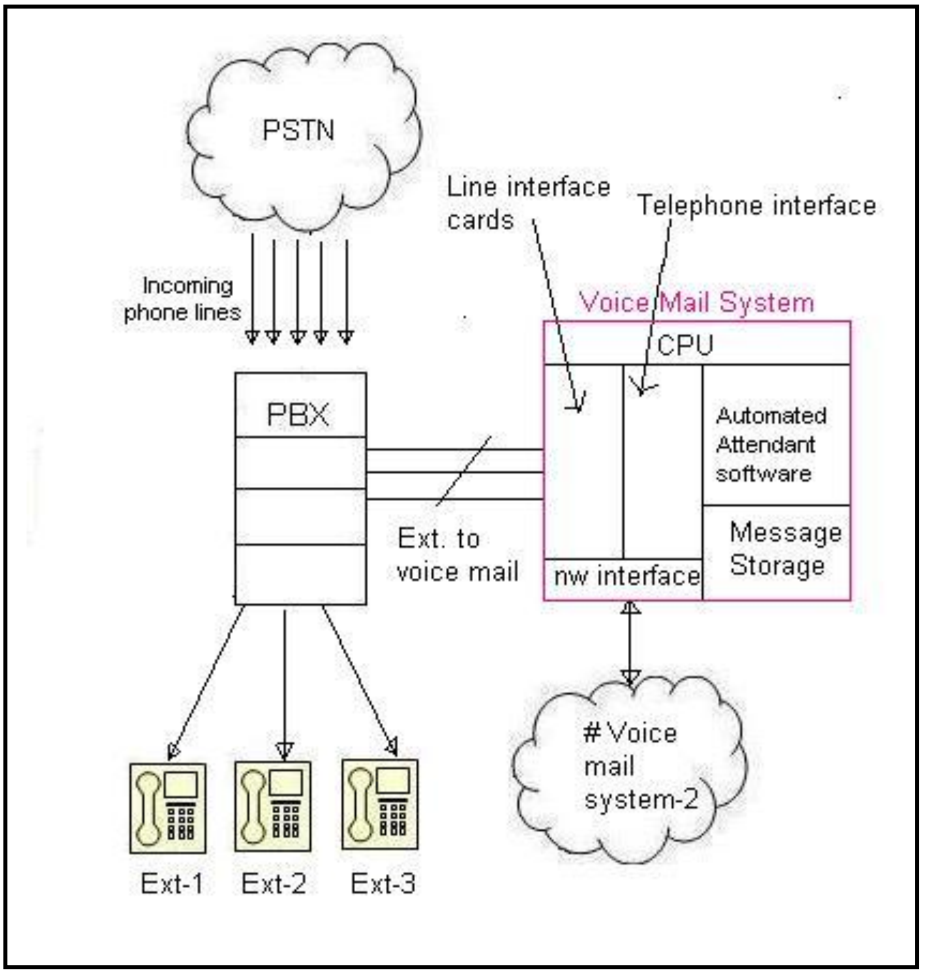


Figure 7-6: A voice mail system. The caller's message is stored in the recipient's voice mail box on disk. Later, the recipient can check his mailbox to get the message.

7.7.3. Facsimile Technology:

Operating something like a *copy machine* connected to a telephone, ***facsimile technology*** uses computer technology and communications links to send quality graphics, charts, text, and even signatures almost anywhere in the world. The drawing or whatever is placed in the facsimile machine at one end, as shown in Figure 7-7, Where it is digitized. Those digits are transmitted across the miles and then reassembled at the other end to form a nearly identical version of the original picture. All this takes only minutes or less. Facsimile is not only faster than overnight delivery services, it is less expensive. Facsimile is abbreviated ***FAX.***

Personal computer users can send and receive faxes directly by means by means of a ***fax modem***, which also performs the usual modem

functions. A user can send computer generated text and graphics. When a fax comes in, it can be reviewed on the computer screen and printed out. if the document to be sent is available only on paper, it must be scanned into the computer first or else be sent using a separate fax machine.

Figure 7-7 faxing it. This facsimile machine can send and receive text, drawings, and graphs long-distance.

7.7.4. Teleconferencing:

An office automation development with cost saving potential is ***teleconferencing***, a method of using technology to bring people and ideas together despite geographic barriers (Figure 7-8). There are several varieties of teleconferencing, but most common today is *videoconferencing*, whose components usually include a large screen, cameras that can send live pictures, and an on-line computer system to record communication among participants.

Videoconferencing has some *disadvantages*. Some people are uncomfortable about their appearance on camera. A more serious fear is that the loss of personal contact will detract from some business functions, especially those related to sales.

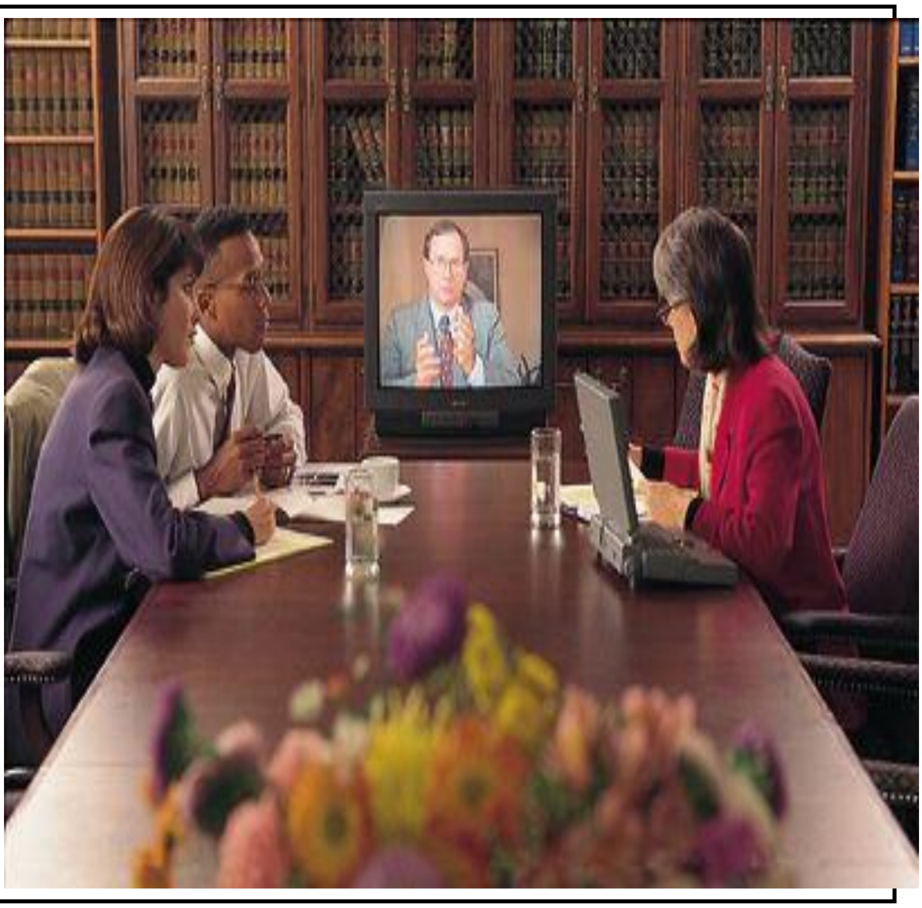


Figure 7-8 A videoconferencing system. Geographically distant groups can hold a meeting with the help of videoconferencing. A camera transmits images of local participants for the benefit of distant viewers.

7.7.5. Electronic Data Interchange:

Businesses use a great deal of paper in transmitting orders. One method devised to cut down on paperwork is ***Electronic Data Interchange*** (***EDI***). *EDI is a series of standard formats that allow businesses to transmit invoices, purchase orders, and the like electronically*. In addition to eliminating paper based ordering forms, *EDI can help to eliminate errors in transmitting orders that result from transcription mistakes made by people*. Since EDI orders go directly from one computer to another, the tedious process of filling out a form at one end and then keying it into the computer at the other end is eliminated. Many firms use *EDI to reduce paperwork and personnel costs.*

7.7.6. Electronic Fund Transfers: Instant Banking:

Using ***Electronic Fund Transfers*** (***EFTs***), people can pay for goods and services by having funds transferred from various accounts electronically, using computer technology. One of the most visible manifestations of EFT is the ***ATM the Automated Teller Machine*** *that people use to obtain cash quickly* (Figure 7-9). A high volume *EFT* application is the disbursement of millions of Social Security payments by the government directly into the recipients’ checking accounts. *Electronic funds transfers* are not limited to transfers between institutions and individuals. Banks and other financial institutions transfer funds among themselves electronically, on both the national and international level.

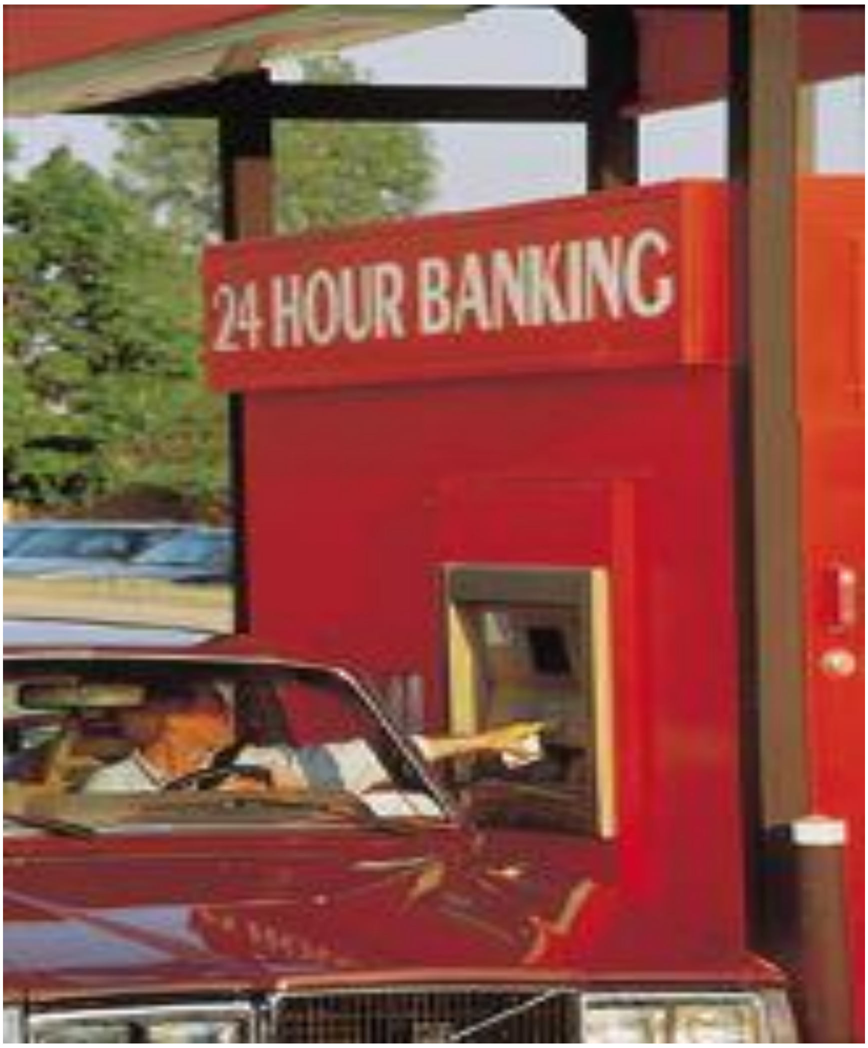


Figure 7-9. An automated teller machine. Users can use bank services 24 hours a day through ATMs.

7.8. THE INTERNET:

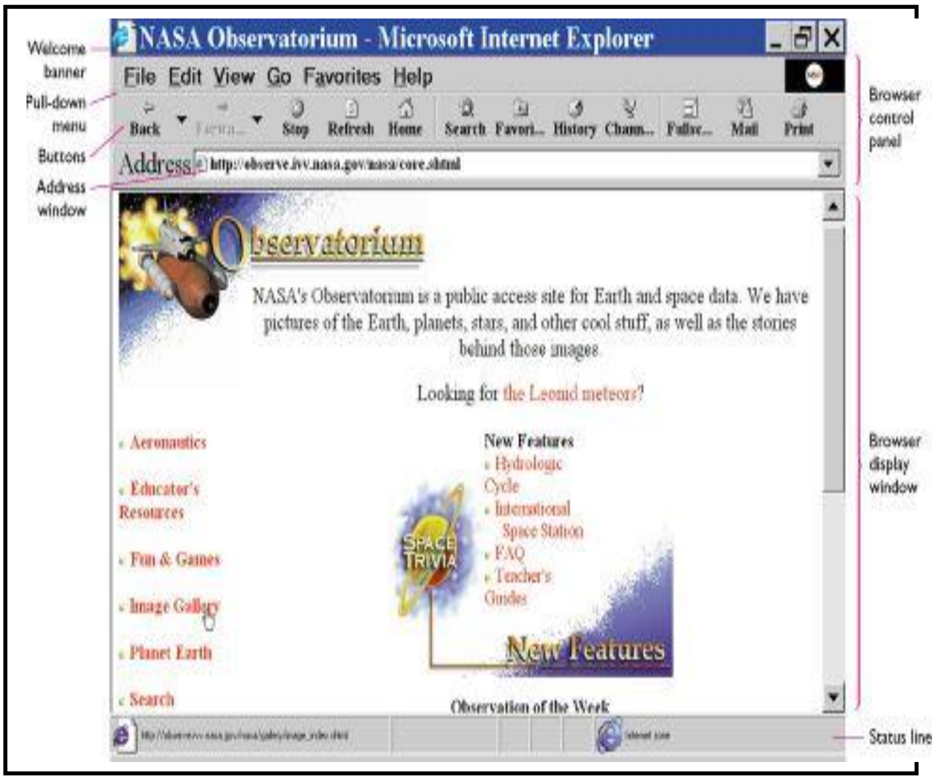
The ***Internet***, sometimes called simply "the ***Net***", is the largest and most far-flung network system of them all. *Networks accessed by computers worldwide*. No one owns the Internet; it has no central headquarters, no centrally. Computers communicate on the Internet using a standardized protocol called ***Transmission Control Protocol/ Internet Protocol (TCP/IP)***. A user must access the Internet through a computer called a ***server***, which has special software that uses the Internet protocol.

7.8.1. Getting Connected:

The Internet is available to individuals through third-party vendors, such as Telecom Egypt. Alternatively, individuals can install personal computer software and be billed at an hourly or monthly rate for access to the Internet.

After being connected, the most attractive method to move around the Internet is the World Wide Web (the Web), which can be navigated with software called a ***browser***. A ***browser*** *is the software on the user's computer that allows the user to access the Internet via the service provider, using a graphical interface*. When you invoke your browser software, it will dial up the Internet service provider and, once successfully connected, display either the ***home page***--initial page--of the web site that created your particular browser. The ***browser*** shows *three* parts on the screen: *two very obvious chunks and a third that is just a line at the bottom*. The *top part* is the browser *control panel*, consisting of lines of menus and buttons, to be described momentarily. The *lower part*, by far the largest part of the screen, is the browser display window. At the

very bottom of the screen is a status line, which indicates the progress of data being transferred as you move from site to site. The status line may also show other messages, depending on the browser. The browser control panel at the top stays the same--except for the changing address of the visited site--as you travel from site to site through the Web; the browser display window changes, showing, in turn, each new Internet site you visit.



7.8.2. The Internet, Intranets, and Extranets in Business

Businesses have become internet worked E-business enterprises. ***<u>The Internet, Intranets, Extranets,</u>*** and other types of networks are now the primary information technology infrastructure

of many organizations. The internet worked ***E-business*** *enterprise enables managers, business professionals, teams, and workgroups to electronically exchange data information in any form(e.g., voice, data, text, and images) anywhere in the world with other end users, customers, suppliers, and business partners.*

7.8.2. 1. *E-Business:*

E-business is defined as the use of Internet technologies to internetwork and empower business process, electronic commerce, and enterprise communications and collaboration within a company as well as with its customers, suppliers, and other business stakeholders. E-business applications rely on telecommunications networks that include ***the Internet, Intranets, and Extranets.***

Electronic business applications of an internet worked enterprise can conceptually be grouped into *three* major groups:

- *Enterprise Communications and Collaboration* - applications that support communication, coordination, and collaboration among the members of business teams and workgroups.
- *Electronic Commerce applications* that support the buying and selling of products, services, and information over the Internet and Extranets.
- *Internal Business applications* of an internet worked E-business enterprise, which support a company’s internal business processes and operations.

7.8.2.2. ***The Internet:***

Business use of the Internet is expanding from an electronic information exchange to a broad platform for strategic business applications. *Business uses of the Internet include:*

- Collaboration among business partners.
- Providing customer and vendor support.
- Buying and selling products and services
- Marketing, sales, and customer service applications.
- Growth of cross-functional business applications.
- Emergence of applications in engineering, manufacturing, human resources and accounting.
- Enterprise communications and collaboration.
- Electronic commerce.
- Strategic business alliances.

7.8.2.3. ***Intranets:***

An ***Intranet*** is a smaller, closed version of the Internet, which can only be accessed by authorized members of an organization.

An ***Intranet*** *is a network inside an organization that uses* ***Internet technologies*** *to provide an Internet-like environment within the enterprise for information sharing, communications, collaboration, and the support of business processes*. It is protected by security measures such as passwords, encryption, and firewalls, and thus can be accessed by authorized users through the Internet. A Company's *Intranet can also be accessed through the Intranets of customers, suppliers, and other business partners via extranet links.*

Intranet applications support communications and collaboration, business operations and

management, web publishing, and Intranet management.

Intranet Technology Resources

Since Intranets are Internet-like networks within organizations, they depend on all of the information technologies that make the Internet possible. These include:

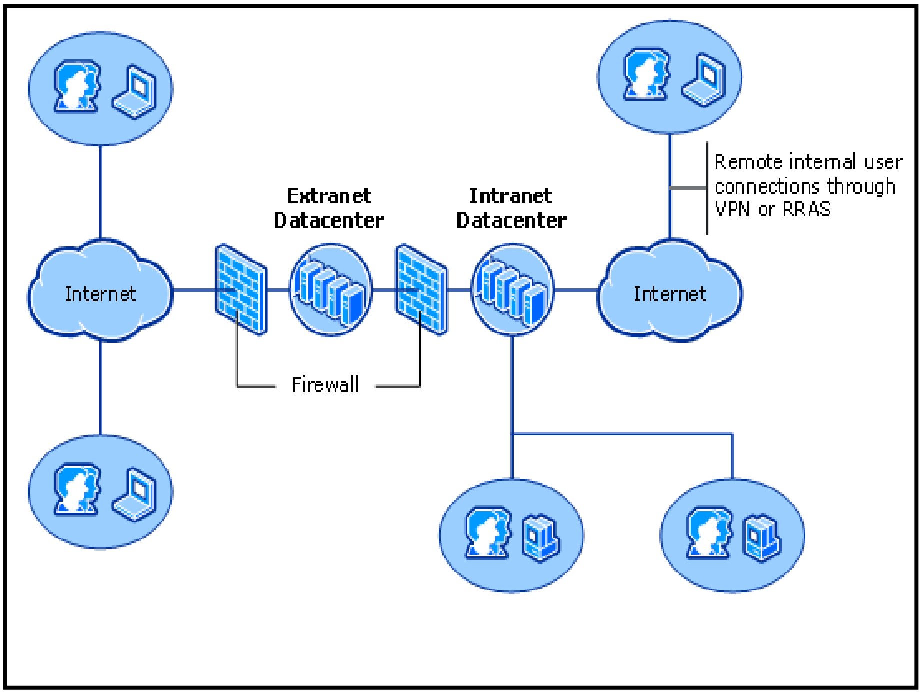
- TCP/IP client/server networks *protocols*
- Hardware and software such as web browsers and server suites.
- HTML (*Hyper Text Markup Language)* is a markup language for describing web documents (web pages).
- Network management and security programs.
- Hypermedia document publishing
- Databases.

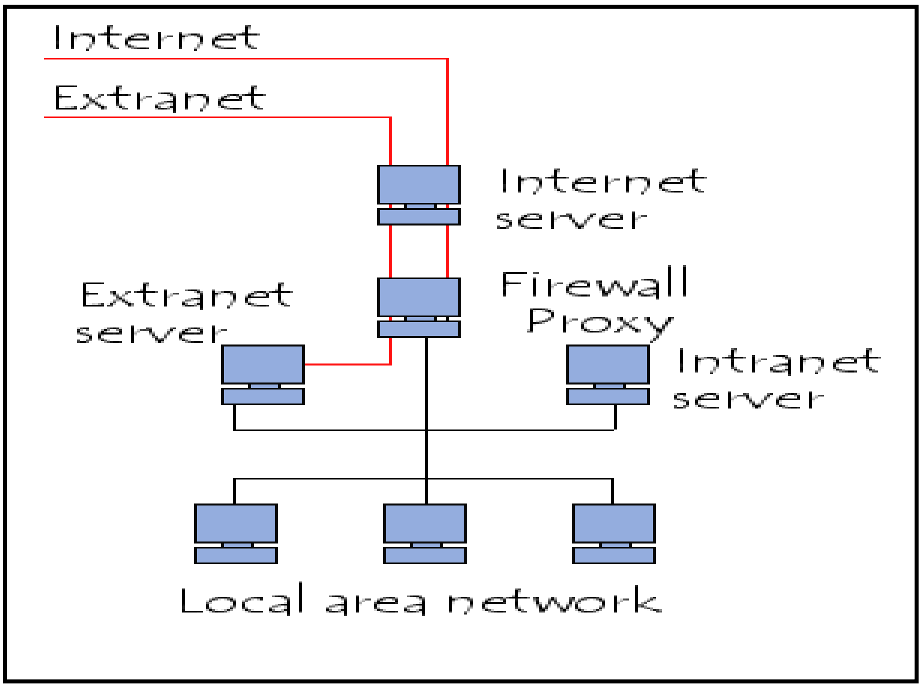
7.8.2.4. ***Extranets:***

An ***Extranet*** is an *Intranet* that is partially accessible to authorized outsiders. ***Extranets*** are *network links that use Internet technologies to interconnect the Intranet of a business with the Intranets of its customers, suppliers, or other business partners*. An ***Intranet*** is normally only accessible by members of the same company or organization; an ***Extranet*** also allows outsiders who have been issued with a password to gain limited access to information held on a company network. Extranets are being used as a way for business partners to share information.

Companies can:

- Establish direct private network links between themselves, or create private secure Internet links between them called *virtual private networks.*
- Use the unsecured Internet as the Extranet link between its Intranet and consumers and others, but rely on encryption of sensitive data and its own firewall systems to provide adequate security.


Remote internal user connections through VPN or RRAS
Extranet Datacenter
Intranet Datacenter
Internet
Internet
Firewall


Internet
Extranet
Internet server
Firewall Proxy
Extranet server
Intranet server
Local area network

Chapter (8)
COMPUTER SOFTWARE APPLICATIONS SOFTWARE AND OPERATING SYSTEMS

8.1. Software: telling the machine what to do.

8.2.Some task-oriented software.

8.3. Operating systems: Hidden software.

8.4. Operating systems for personal Computers.

8.5. Computers and People.

LEARNING OBJECTIVES :

- **Understand the difference between operating systems and applications software.**
- **List various types of task oriented software.**
- **Understand, in a general way, the kinds of software available for both large and small businesses.**
- **Know the functions of an operating system.**
- **Understand the basics of a personal computer operating system.**
- **Understand the need for resource allocation on large computers.**
- **Appreciate ethical issues associated with software.**
- **Learn the functions of various computer people.**

8.1. SOFTWARE: TELLING THE MACHINE WHAT TO DO :

When people think about computers, they usually think about machines. It is really the software the planned, step by step set of instructions required to turn data into information that makes a computer useful.

Software can be categorized as ***system software or applications software.***

System Software known as the ***operating system***, *the underlying software found on all computers*.

Applications Software *can be used to solve a particular problem or to perform a particular task.*

8.1.1. Applications Software

Applications software may be either ***custom or packaged***. Many large organizations pay computer programmers- people who design,

write, test, and implement software to write custom software, software that is specifically tailored to their needs. Custom software for the tasks of a large organization may be extremely complex and take a lot of time- possible years- to write.

The average person is most likely to deal with software for personal computers, called *packaged software or commercial software*. Packaged software for personal computers often comes in a box that is as colorful as that of a board game. Inside the box you will find one or more disks holding the software and, usually, an instruction manual, also referred to as documentation. Software usually comes on a CD-ROM and requires a *setup- installation-* process before use. Furthermore, for future convenience, the setup process copies some or all of the new

software to the hard disk drive. Some software may require the CD-ROM to be in the drive whenever the software is used. Once the software is installed, you can click its ***Icon***, *its picture image on the screen*, or type an instruction-command- to get the program started. A great assortment of software is available to help you with a variety of tasks- writing papers, preparing budgets, storing and retrieving information, drawing graphs, playing games, and much more. This wonderful array of software is what makes computers so useful. Most personal computer software is designed to be *user-friendly*. It usually means that the software is supposed to be easy--perhaps even intuitive--for a beginner to use or that the software can be used with a minimum of training and documentation.

8.1.2. Acquiring Software:

Sometimes software is *free*. Software is called ***freeware*** if its author chooses to provide it free to all. However, *freeware* may or may not be copyrighted- that is, have restrictions of use placed upon it. Un-copyrighted software is considered to be in the *public domain* and may be used, or even altered, without restriction. Sometimes freeware, perhaps written by a student or educator, is offered without fee and without copyright. Other freeware may be offered to the public as a marketing tool by a major manufacturer, who will most certainly copyright it and maintain all ownership rights. *Software called* ***shareware*** *is also given away free,* but the maker hopes for voluntary payment-that is, he or she hopes that you like it well enough to send a contribution.

The software that people use most often, packaged software such as word processing or spreadsheet software, sometimes called *commercial software*, is probably both copyrighted and at least somewhat costly. This kind of software must not be copied without permission from the manufacturer. In fact, software manufacturers call making illegal copies of commercial software *software piracy.*

An organization, as opposed to individual users, must take a different approach in acquiring Software. Most organizations-businesses, government, nonprofit agencies-have computers, and their users, of course, need software. The most widespread solution is obtaining vendor permission to copy software legally, an approach called *site licensing*. Typically, a site license permits an organization, for a fee, to make a

limited number of copies of a software product. The customer agrees to keep track of who uses it and takes responsibility for copying and distributing manuals to its own personnel.

Organizations with local area networks usually install widely used software such as word processing on the network's server computer. Thus the software is available to users connected to the network without the necessity of installing the software on each user's computer.

Another software movement is afoot: *Electronic software distribution*. A user can simply pay to *download* the software-move it from another computer to the user's computer over data communications links. Downloading software from the internet is already a reality; many users get freeware, shareware, and even copyrighted software from the internet. One

common scenario is to download copyrighted software free for a trial period.

8.2. SOME TASK-ORIENTED SOFTWARE:

Most users, whether at home or in business, are drawn to *task-oriented software*, sometimes called productivity ***software*** that can make their work faster and their lives easier. ***The major categories of task-oriented software are word processing (including desktop publishing), spreadsheets, database management, graphics, and communications.*** Further, software designated as office suites offers some combination of these categories in a single package.

8.2.1. Word processing/ Desktop Publishing:

The most widely used personal computer software is *word processing software*. Business people use word processing for *memos, reports,*

correspondence, minutes of meetings, and anything else that someone can think of to type. <u>*Word processing software*</u> **lets you *create, edit, format, store, and print text and graphics in one document.*** Since you can store on disk the memo or document you typed, you can ***retrieve it another time, change it, reprint it,*** or do whatever you like with it. Unchanged parts of the stored document do not need to be retyped; the whole revised document can be reprinted as if new.

As the number of features in word processing packages has grown, word processing has crossed the border into <u>*desktop publishing territory*</u>. <u>***Desktop publishing packages***</u> *are usually better than word processing packages at meeting high-level publishing needs, especially when it comes to typesetting and color reproduction*. Many

magazines and newspapers today rely heavily on desktop publishing software. Businesses use it to produce professional-looking newsletters, reports, and brochures both to improve internal communication and to make a better impression on the outside world.

8.2.2. Electronic Spreadsheets:

Spreadsheets**, made up of columns and rows of numbers, has been used as business tools for centuries.* A manual spreadsheet can be tedious to prepare, and when there are changes, a considerable amount of calculation may need to be redone. An *electronic spreadsheet* is still a spreadsheet, but the computer does the work. In particular, ***spreadsheet software automatically recalculates the results when a number is changed. The ability to ask, *"what if ...?"* and then see the results on the computer before

actually committing resources helps business people make better, faster decisions.

8.2.3. Database Management:

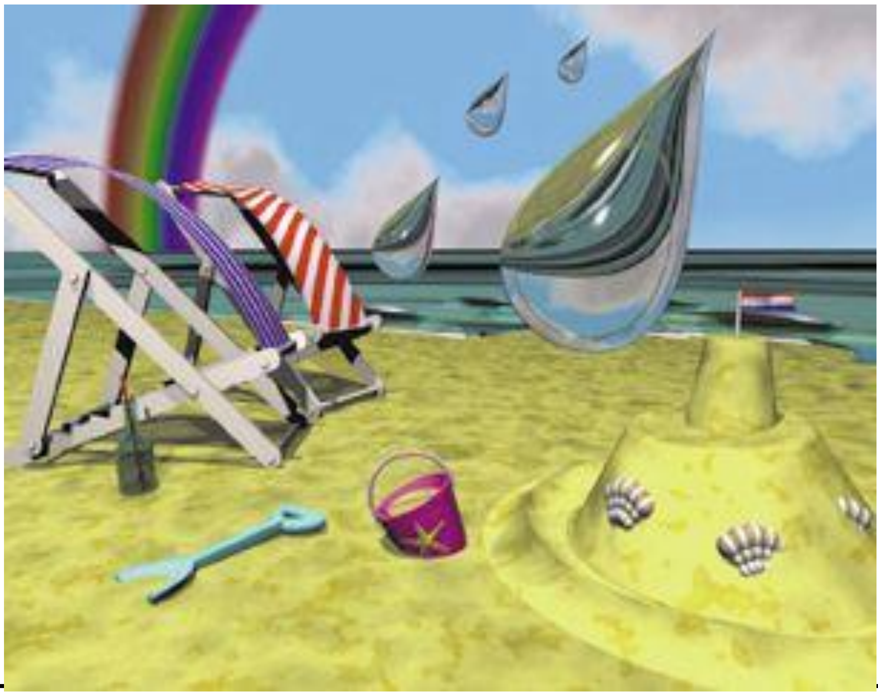
Software used for ***database management*** the management of a collection of interrelated facts handles data in several ways. The software ***can store data, update it, manipulate it, retrieve it, report it in a variety of views, and print it in as many forms***. By the time the data is in the reporting stage given to a user in a useful form it has become information. *Database software* can be useful for anyone who must keep track of a large number of related facts.

8.2.4. Graphics

Graphs, Maps, and Charts can help people compare data, spot trends more easily, and make decisions more quickly. Besides dressing up facts and figures, graphics are often used by

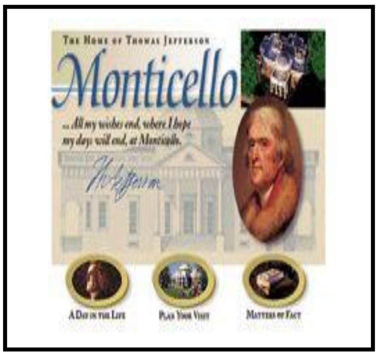
business people, or anyone with a message to deliver, as part of a presentation.

The most pleasing use of ***graphics software*** is the work produced by graphic artists, people who have both artistic ability and the skills to use sophisticated graphics software to express their ideas. Artists use software as a tool of their craft to produce stunning computer art.



8.2.5. Communications:

From the viewpoint of an individual with a personal computer at home, ***communications* means in simple terms that he or she can hook a phone up to the computer and communicate with the computer at the office or access data stored in another computer in another location.** The most likely way for such a user to connect to others is via the Internet. A user needs software called a *browser* to access the Internet. A ***browser*** may be a single software package or it may be included as part of other software offerings.



8.2.6. Office Suites:

Since most people need to use the kinds of task oriented software just described, some choose to buy a ***suite*** a *group of basic software designed to work together*. If you buy word processing software from one manufacturer and a spreadsheet package from another, they may be incompatible. Using suite software, however, means that you could easily build a spreadsheet and then move it into a report you are preparing using word processing. Another advantage of suites is that the various packages have the same “look and feel” the same buttons and menus and overall appearance.

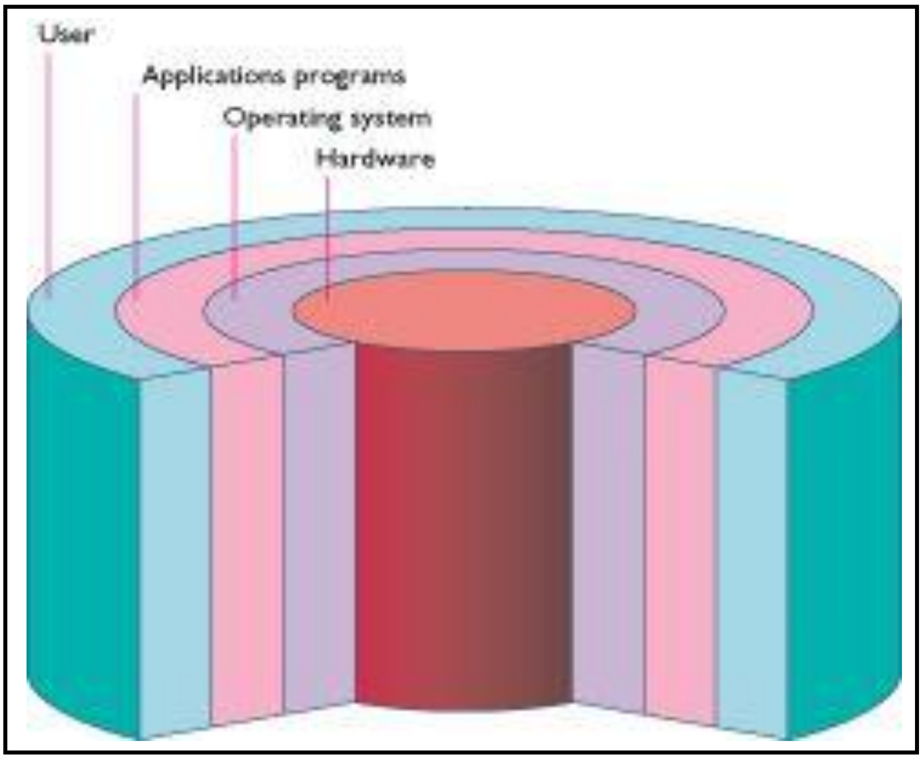
Most personal computers come with simple suites that feature word processing, spreadsheet, and graphics programs. In fact, one of the most common office applications of suites is *mail*

merge, in which certain names and addresses from a database are used on letters prepared using word processing. Two or three software makers have dominated the suite market for years and continue to offer software upgrades newer and better versions.

8.3. OPERATING SYSTEMS: HIDDEN SOFTWARE:

When a brand new computer comes off the factors assembly line, it can do nothing. The hardware needs software to make it work. *The applications software cannot communicate directly with the hardware*, so the *operating system serves as intermediary software between the applications software and the hardware.* An ***Operating System* is a set of programs that lies between applications software and the computer hardware; it is the fundamental software that**

controls access to all other software and hardware resources.



A conceptual diagram of an operating system.

The term ***systems software*** is sometimes used interchangeably with *operating system*, but ***systems software means all programs related to***

coordinating computer operations. ***Systems software includes the operating system, programming language translators and a variety of service programs.***

The most important program in the operating system, the program that manages the operating system, is the **supervisor program***, most of which remains in memory and is thus referred to as resident.* The supervisor controls the entire operating system and loads into memory other operating system programs (called *nonresident*) from disk storage only as needed.

Most users today have a computer with a hard disk drive. No matter what operating system is being used, when the computer is turned on, the operating system will be loaded from the hard drive into the computer’s memory, thus making it available for use. ***The process of loading the***

operating system into memory is called bootstrapping, or booting the system. The word ***booting*** is used because; *the operating system pulls itself up by its own bootstraps*. When the computer is switched on, a small program in memory automatically pulls up the basic components of the operating system from the hard disk.

An ***operating system*** has ***three*** main functions:

(1) To manage the computer's resources, such as the central processing unit, memory, disk drives, and printers,

(2) To establish a user interface, and

(3) To execute and provide services for applications software.

However, that much of the work of an operating system is hidden from the user, many

necessary tasks are performed behind the scenes. In particular, the first listed function, managing the computer's resources, is taken care of without the user being aware of the details. Furthermore, all input and output operating, although invoked by an applications program, are actually carried out by the operating system.

Although much of the operating system functions are hidden from view, you will know when you are using an applications software package, and this requires that you invoke call into action the operating system. Thus you establish a user interface and also execute software.

8.4. OPERATING SYSTEMS FOR PERSONAL COMPUTERS:

If you peruse software offerings at a retail store, you will generally find the software

grouped according to the operating system on which the software can run. Generally, applications software word processing, spreadsheets, games, whatever can run on just one operating system. Software makers must decide for which operating system to write an applications software package, although some make versions of their software for more than one operating system.

Users, though, do not set out to buy an operating system; they want computers and the applications software to make them useful. However, since the operating system determines what software is available for a given computer, they must at the least be aware of their own computer's operating system.

Although operating systems differ, many of their basic functions are similar. There are

numerous operating systems used on most personal computers: *DOS (Disk Operating System), Macintosh Operating Systems (Mac OS), and Microsoft Windows.*

8.4.1. *DOS (Disk Operating System)*

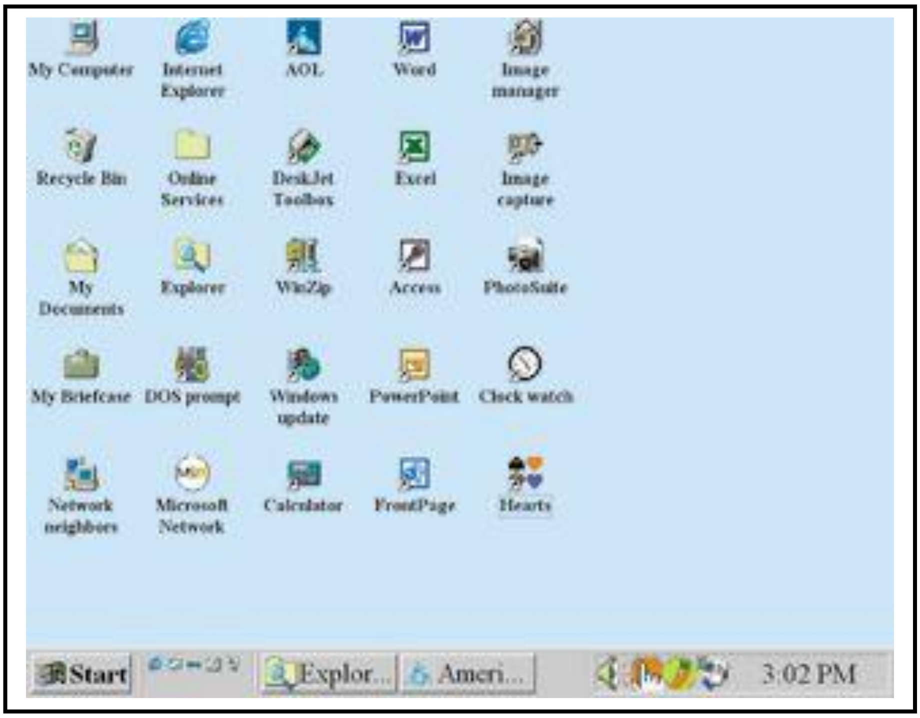
Is for single-user IBM-compatible computers. Microsoft Corporation sells this product under the name MS-DOS (***Microsoft Disk Operating System***) and licenses another version, called PC-DOS, to IBM for use in its personal computers. DOS was written for the microcomputer technology of the early 1980s. An enormous number of microcomputers still run under DOS. Even though there have been numerous improvements to the software since its introduction, limitations still exist.

8.4.2. *Macintosh Operating Systems (Mac OS)*

Was introduced in the 1984 and was the first commercial GUI platform. The latest version supports multitasking, includes multiple Web browsers, and has built-in networking capability. It also is able to open, edit, and save files created in DOS and Windows platforms.

8.4.3. Microsoft Windows:

The operating system called ***Microsoft Windows***– Windows for short uses a *colorful graphics interface* that, among other things, eases access to the operating system. Microsoft windows define the operating environment standard for computers with *Intel processors.* Most new personal computers come with Windows already installed.



8.4.3.1. A Windows Overview:

The feature that makes Windows so easy to use is a ***Graphical User Interface*** (***GUL***), in which users work with on-screen pictures called ***icons*** and *with menus rather than with keyed-in commands*. Clicking icons or menu items activates a command or function. The menus are called ***pull-down menus*** because they appear to

pull down like a window shade from the original selection. Some menus, in contrast, called ***pop-up menus***, originate from a selection on the bottom of the screen. Furthermore, icons and menus encourage pointing and clicking with a mouse, an approach that can make computer use fast, easy, and intuitive.

Windows features a Start button in the lower-left corner just waiting to be clicked. From this beginning you can conveniently find a program or a file. Programs can also be invoked started by a *double click* on an icon on the desktop, the Windows opening screen. You could double click the icon labeled Hearts to launch that program a game. Perhaps the greatest convenience is the task bar along the bottom of the screen, an array of buttons for each active program, that is, a program in current use. You can click from one

active program to another as easily as changing channels on your TV. As another example of convenience, long file names, up to 255 characters, are permitted.

Anyone who has added a new component, perhaps a modem or a sound card, to an existing computer knows that it must be configured to the system, a process that may involve some software and even hardware manipulations. Windows supports plug and play, a concept that lets the computer configure itself when a new component is added. However, for plug and play to become a reality, hardware components must also feature the plug and play standard. Once a peripheral is built to the plug and play standard, a user can install it simply by plugging it in and turning on the computer. Windows recognizes that a new

device has been added and proceeds to configure it.

A Windows technology called ***object linking and embedding*** (***OLE***) lets you *embed or link one document with another*. For instance, you could embed a graphic within a document created in a desktop publishing program that supports OLE. When you click the graphic to edit it, you are taken to the graphics program in which you created the graphic. Some notable *features* of the latest version of Windows are:

- *Internet/ intranet browsing capabilities*. Microsoft's Brower, Internet Explorer, is included with Windows. In fact, Windows itself has been made to look more like a browser.
- *Support for state of the art hardware*. This includes support for Digital Video Disk

(DVD) and the latest multimedia components.

- *Support for huge disk drives*. Everyone wants more hard disk space, and today's enormous drives provide the answer. Support for high capacity drives is provided in Windows in the form of tables that can handle the larger numbers.
- *TV viewer and broadcast ability*. A broadcast enabled computer blends television with new forms of information and entertainment. It blurs the line between television, web pages, and computer content. It also enables the reception of broadcast web pages and other live data feeds, such as across the screen news headlines and stock quotes.

- *Wizards.* Windows lets users accomplish various tasks using "wizards", software that makes tasks user friendly.

Further, Windows includes technologies to help reduce the cost of owning and maintaining a personal computer. Other features include improved backup, improved interfaces with other software, new and improved networking features, and increased security.

8.4.3.2. Windows NT:

The operating system called Windows NT (for new technology) is meant mostly for corporate, networked environments. Beginning with version 4.0, NT looks exactly like Windows 98 and runs most of the software that runs under Windows 98. But beneath the surface, Windows NT is far more robust and heavy duty. It has been

engineered for stability and, as befits a networked environment, has much stronger security features.

For home users, the features that make Windows NT attractive to businesses may be overkill. Furthermore, Windows NT requires much more memory and hard disk space probably triple for each than does Windows 98. Technical support costs more too, closer to what a business would expect to pay.

8.4.3.3. Windows 2000:

Windows NT becomes Windows 2000, which merges Windows NT 4.0’s stability with Windows 98’s setup and hardware awareness. Windows 2000 is designed for both work and home use.

The most noticeable feature is that Windows 2000 software knows who you are. One computer can serve many people. Once you tell it who you

are, it will immediately reconfigure to your preferences. It personalizes the Start menu so programs used most frequently are visible and others are hidden. Windows 2000 also knows what you are using. Dynamic layout features will consider what kind of screen you are on (handheld, TV, PC), what size it is, and so on, and then adjust its size and format accordingly. A particularly attractive feature is the self healing applications software if you accidentally delete a necessary component, Windows will restore it.

8.4.4. Linux

Is an interesting operating system because it is not proprietary software. Its code has been made publicly available (called open-source software). This allows users to customize the software to meet their personal needs and to share improvements made with others.

8.4.5. UNIX

Was developed in the 1970's, and is one of the few small-scale operating systems that is both multiuser and multiprocessing capable. This allows computers running on UNIX to process a high volume of inputs from multiple users by using multiple CPUs simultaneously.

8.5. Computers and People:

Many organizations have a department called *Management Information Systems* (*MIS*) or *Computer Information Systems* (*CIS*), *Computing Services*, *Information Services*, or *Information Technology*. Whatever it is called, this department is made up of people responsible for the computer resources of an organization. Large organizations, such as universities, government agencies, and corporations, keep much of the institution's data in computer files: research data,

engineering drawings, marketing strategy, accounts receivable, accounts payable, sales facts, manufacturing specifications, transportation plans, and so forth. The people who maintain the data are the same people who provide service to the users: the computer professionals. ***Data entry operators*** *prepare data for processing, usually by keying it in a machine readable format.* ***Computer operators*** *monitor the computer, review procedures, keep peripheral equipment running, and make backup copies of data.* ***Librarians*** *catalog the processed disks and tapes and keep them secure.* ***Computer programmers****, design, write, test, implement, and maintain the programs that process data on the computer system; they also maintain and update the programs.* ***Systems analysts*** *are knowledgeable in the programming area but have*

broader responsibilities. They plan and design not just individual programs but entire computer systems. Systems analysts *maintain a working relationship with both programmers and the users in the organization*. ***The analysts*** *work closely with the users to plan new systems that will meet the users' needs*. A ***professional*** called a ***network manager*** *implements and maintains the organization's network(*s). The ***department manager***, often called the ***chief information officer (CIO)***, must *understand more than just computer technology.* This person must *understand the goals and operations of the entire organization and be able to make strategic decisions.*

Chapter 9
PROGRAMMING CONCEPTS
AND
DESIGN TECHNIQUES

9.1 What programmers do?

9.2 The Programming process.

9.2.1 Defining the problem.

9.2.2 Planning the solution.

9.2.3 Coding the program.

9.2.4 Testing the program.

9.2.5 Documenting the program.

9.3. Programming Languages.

LEARNING OBJECTIVES:

- **To discuss the terminology and concepts associated with programming languages and software.**
- **To identify approaches to solving a programming problem.**
- **To describe the concept of structured programming.**
- **To demonstrate an understanding of the principles and use of flowcharting and other program design techniques.**
- **To classify the various types of program instructions.**

You may already have used software, perhaps for word processing or spreadsheets, to solve problems. Perhaps now you are curious to learn how programmers develop software. As noted earlier, a *program is a set of step-by-step instructions that directs the computer to do the tasks you want it to do and produce the results you want.* A set of rules that provides a way of telling a computer what operations to perform is called a *programming language*. There are at least *three* good reasons for learning programming:

- Programming helps you understand computers. The computer is only a tool. If you learn how to write simple programs, you will gain more knowledge about how a computer works.
- Writing a few simple programs increases your confidence level. Many people find great

personal satisfaction in creating a set of instructions that solve a problem.

- Learning programming lets you find out quickly whether you like programming and whether you have the analytical turn of mind programmers need. Even if you decide that programming is not for you, understanding the process certainly will increase your appreciation of what programmers and computers can do.

9.1. WHAT PROGRAMMERS DO?

In general, the *programmer's job* is *to convert problem solutions into instructions for the computer.* That is, the *programmer* ***prepares*** *the instructions of a computer program* and ***runs*** *those instructions on the computer*, ***tests*** *the program to see if it is working properly*, and ***makes corrections*** *to the program.* The

programmer also ***writes** a report on the program*. These activities are all done for the purpose of helping a user fill a need, such as paying employees, billing customers, or admitting students to college. The programming activities just described could be done, perhaps, as solo activities, but a programmer typically interacts with a variety of people. For example, if a program is part of a system of several programs, the programmer coordinates with other programmers to make sure that the programs fit together well. If you were a programmer, you might also have coordination meetings with users, managers, systems analysts, and with peers who evaluate you're work-just as you evaluate theirs.

9.2. THE PROGRAMING PROCESS:

Developing a program involves steps similar to any problem-solving task. There are ***five*** main ingredients in the programming process:

1. ***Defining the problem.***
2. ***Planning the solution.***
3. ***Coding the program.***
4. ***Testing the program.***
5. ***Documenting the program.***

9.2.1. Defining the Problem:

Suppose that, as a programmer, you are contacted because your services are needed. You meet with users from the client organization to analyze the problem, or you meet with a systems analyst who outlines the project. Specifically***, the task of defining the problem consists of identifying what it is you know (input--the data given) and what it is you want to obtain (output--the result)***.

Eventually, you produce a written agreement that, among other things, specifies the kind of input, processing, and output required.

9.2.2. Planning the Solution:

Three common ways of *planning the solution to a problem* are ***to draw a flowchart***, ***to write pseudo code***, and ***to use a structured program design.***

9.2.2.1. Flowchart:

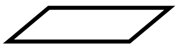
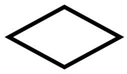
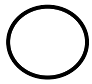
Flow chart **is a** ***pictorial representation of a step-by-step solution to a problem***. It consists of *arrows* representing the direction the program takes and *boxes* and *other symbols* representing actions. ***It is a map of what your program is going to do and how it going to do it***. The ***American National Standards Institute (ANSI)*** has developed a standard set of flowchart symbols. As a practical matter, few programmers use flowcharting in their

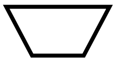
work, but flowcharting retains its value as a visual learning tool.

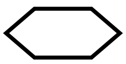
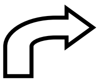
The combination of symbols and flow lines portrays the logic of the program or system. The more commonly used flowchart symbols are shown in Figure (9-1).

Each symbol indicates the type of operation to be performed, and the flowchart graphically illustrates the sequence in which the operations are to be performed. Flow lines → depict the sequential flow of the program logic. A rectangle signifies some type of computer process. The process could be as specific as "Compute an individual's grade average" (in a program flowchart) or as general as "Prepare class schedules for the fall semester" (in a system Flow chart). The predefined process , special case of the process symbol, is

represented by a rectangle with extra vertical lines. The predefined process refers to a group of operation that may be detailed in a separate flowchart.

The parallelogram  is  a generalized input/output symbol that denotes any type of input to or output from the program or system. The diamond-shaped symbol  marks the point at which a decision is to be made. In a program flowchart, a particular set of instructions is executed based on the outcome of a decision. For example, in payroll program gross pay is computed differently for hourly and commission employees; therefore, for each employee processed, a decision is made as to which set of instruction is to be executed.

Each flowchart must begin and end with the oval terminal point symbol  . A small circle is a connector and is used to break and then link flow lines. The connector symbol often is used to avoid having to cross lines. The trapezoid  indicates that a manual process is to be performed. Contrast this with a computer process represented by a rectangle. The bracket ... {permits descriptive notations to be added to flowcharts.

The on-line data storage symbol  represents a file or data base. The most common specialized input/output symbols are the workstation  and the printer (hard copy)  symbol. These symbols are equally applicable to system and program flowcharting and can be used to develop and represent the logic for each.

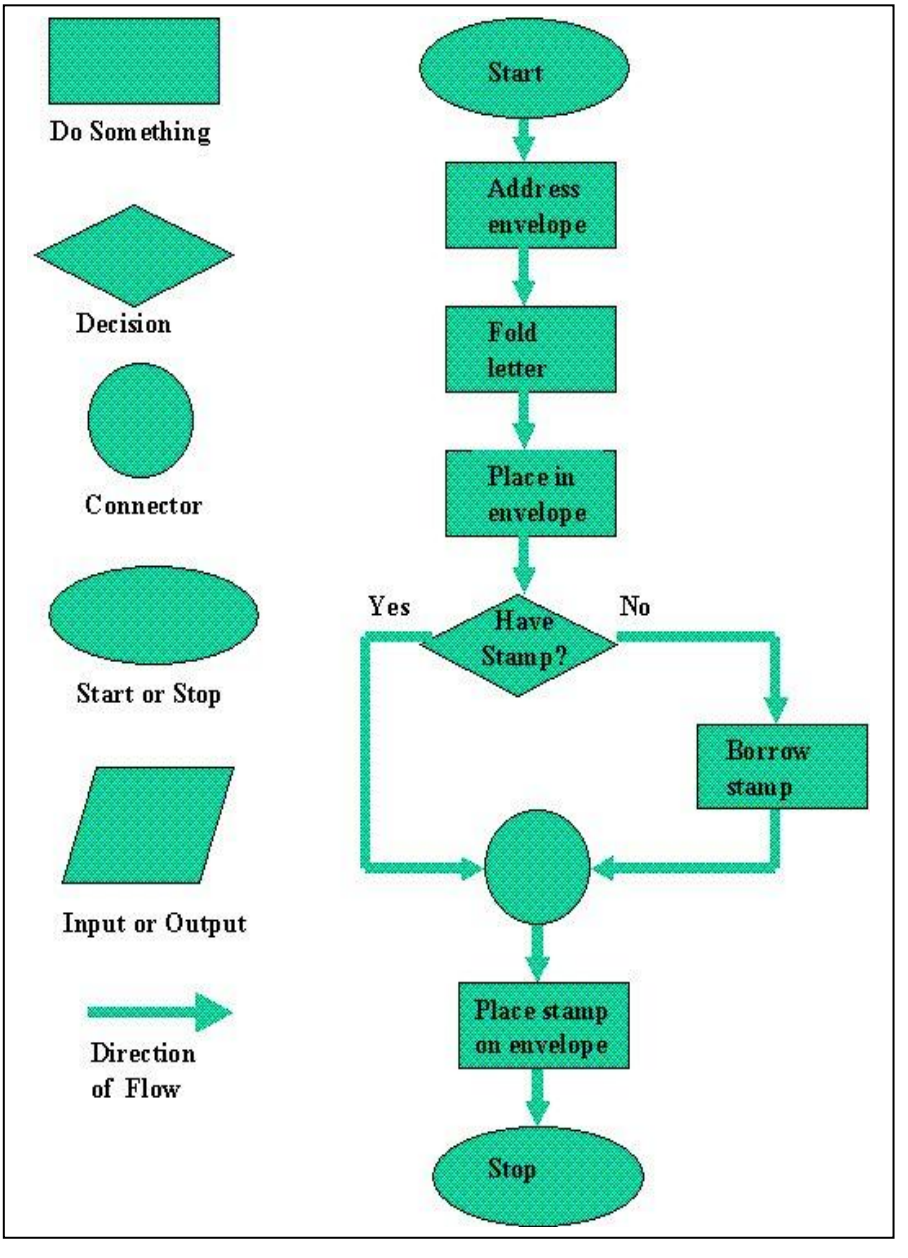


Figure 9- 1 Flowchart symbols and a simple flowchart

9.2.2.2. Pseudo code:

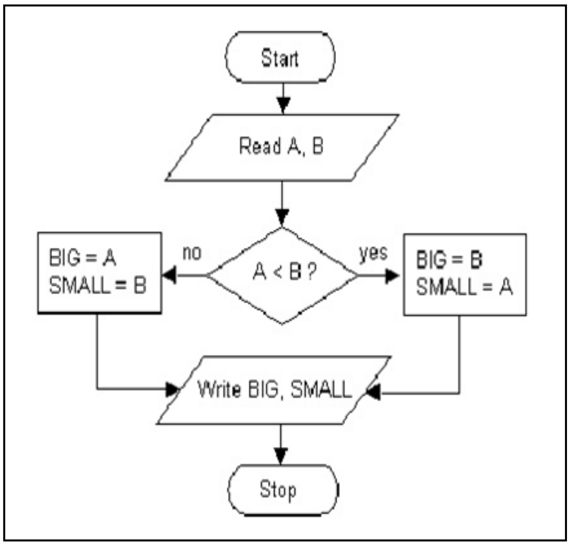
Pseudo code is *an English-like way of representing the solution to a problem. It is considered a "first draft" because the pseudo code eventually has to be translated into a programming language*. Although pseudo code is like English and has some precision to it, it does not have the very definite precision of a programming language.

Pseudo code is not executable on the computer. When using pseudo code to plan a program; you can concentrate on the logic and not worry about the rules of a specific language. ***Pseudo code*** is *easier to maintain than a flowchart* if you discover a flaw in your logic; once it is coded in a programming language; most people find that it is more difficult to change logic. ***Pseudo code*** *can be translated into*

a variety of programming languages, such as PASCAL or COBOL. It is helpful to introduce pseudo code in relation to flowcharting.

An *advantage* of pseudo code is that it eliminates the time spent with flowcharting to draw and arrange symbols while attempting to determine the program logic. The major *disadvantage* is that unlike flowcharting, pseudo code does not provide a graphic representation, which many people find useful and easier to interpret when examining programming logic. In Figure (9-2) the logic of a simple program is represented both in pseudo code and by a flowchart.

Flowchart ***Pseudo code***



Read A, B

If A is less than

BIG = B

SMALL = A

Else

BIG = A

SMALL = B

Write (Display) BIG, SMALL

Figure (9-2)

There is no substitute for good, sound logic in programming. If you follow the guidelines of structured programming and make judicious use of these and other program design techniques, your program will be easier to write, use, and maintain.

9.2.2.3. Structured Program Design:

Structured programming *is a technique that emphasizes breaking a program into logical sections by using certain programming standards.* Structured programming is a methodology that emphasizes ***three*** main program design concepts: ***structure charts, control structures, and single entry/single exit.*** Use of these concepts helps to create programs that are easy to write, read, understand, check for errors, and modify.

9.2.2.3.1. Structure Charts:

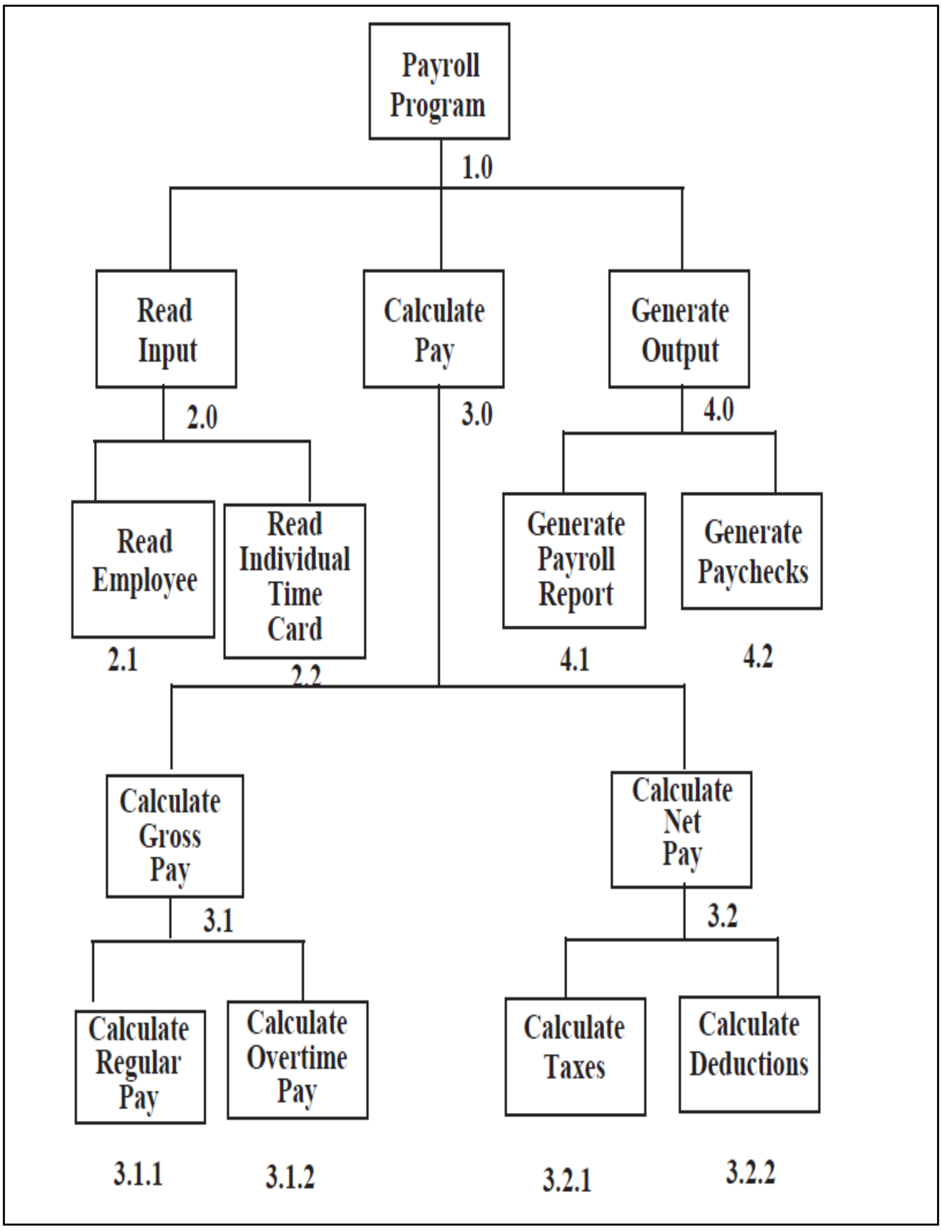
A Structure Chart graphically illustrates the structure of a program by showing independent hierarchical steps this high-level picture identifies major functions that initial component parts of the structure chart each major component is then broken down into subcomponents, which are, in

turn, broken down still further until sufficiently detailed components are shown. Since the components are pictured in hierarchical form, a drawing of this kind is also known as a *hierarchy chart. A structure chart is easy to draw and easy to change, and it is often used to supplement or even to replace a logic flowchart.*

The structure chart permits a programming problem to be broken into a hierarchy of tasks (Any task can be broken into subtasks if a finer level of detail is desired.) The most effective programs are designed to be written in ***modules***, or independent tasks. It is much easier to address a complex programming problem in small, more manageable modules than as one big task. This is done using the principles of structured programming.

In structured programming, the logic of the program is addressed hierarchically in logical modules (figure 9-3). In the end, the logic of each module is translated into a sequence of program instructions that can be executed independently. By dividing the program into modules, the structured approach to programming reduces the complexity of the programming task. Some programs are so complex that if taken as a single task, they would be almost impossible to conceptualize, design, and code. We must use modular programming. Thus, the complex programs can be organized into smaller manageable pieces (modules) in a relatively standard way .The structure chart illustrates the structure of a program by depicting its parts as independent hierarchical modules.

FIGURE (9-3) a structure chart



9.2.2.3.2. Control Structure:

Control structures control how the program executes. Structured programming uses a limited number of control structures to minimize the, complexity of programs and thus to cut down on errors. *There are **three** basic control structured **Programming Sequence, Selection, and Iteration (Looping).***

These three are considered the basic building blocks of all program construction.

*** *Sequence*:**

The sequence control structure is the straightforward: one statement simply follows another in sequence.

**** Selection:***

The selection control structure is used to make logical decisions. This control structure has *two* forms: ***IF-THEN-ELSE*** and ***IF-THEN***. The *IF*-

THEN-ELSE control structure works as follows: IF (a condition is true), THEN (do something), ELSE (do something different). IF-THEN is special case of IF-THEN-ELSE. IF (a condition is true), THEN (do something), but if it is not true then do nothing.

****Iteration-Looping:***

The iteration control structure is a *looping mechanism.* The only necessary iteration structure is the *DOWHILE structure*. An additional form of iteration is called *DOUNTIL*; ***DOUNTIL*** is really just a *combination of sequence and DOWHILE*. Although DOUNTIL is not one of the three basic control structures, it is convenient to introduce the DOUNTIL structure now.

If you put the loop-ending decision at the beginning, it is called a trailing decision. The

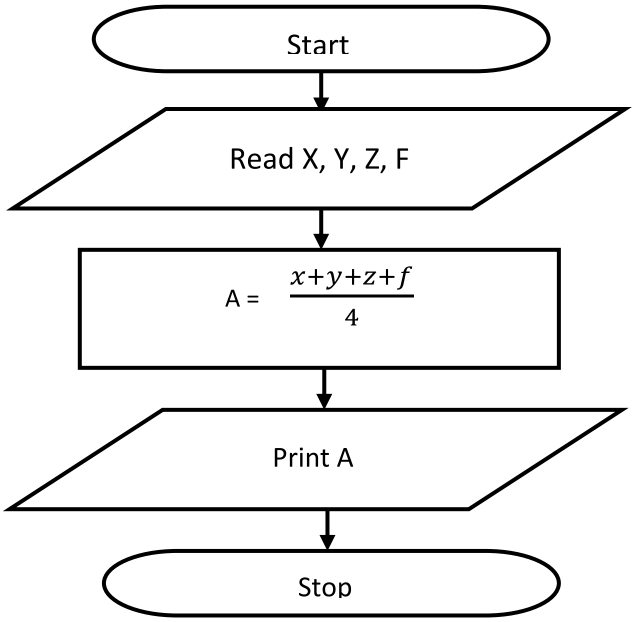
position of the decision constitutes the basic difference between DOWHILE and DOUNTIL. DOWHILE tests at the beginning of the loop; the diamond shaped decision box is the first action of the loop process. The DOUNTIL loop tests at the end. The condition of DOUNTIL must be false to continue the loop; this is an important difference from the DOWHILE loop.

9.2.2.3.3. Single Entry/Single Exit:

An important concept in structured programming is *single entry/single exit*, *meaning that there is only one entry point and one exit point for each of the three control structure*. An entry point is the point where a control structure is entered. An exit point is the point where the control structure is exited.

Example 1:

Draw a program flowchart to read the variables X, Y, Z and F - and print the average A.

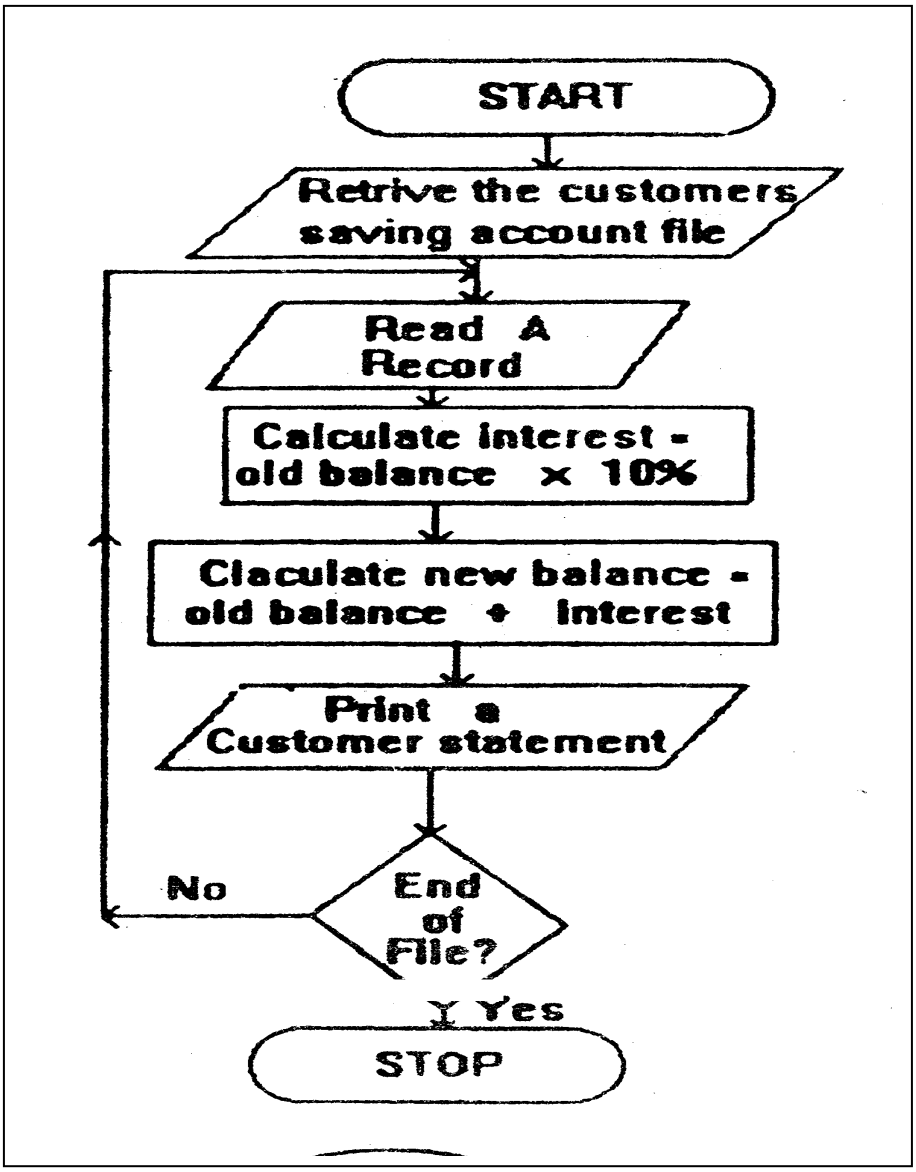


Example 2:

Draw a program flow-chart to calculate the amount of interest for a bank savings account. The interest rate is 10%. The old balance data are stored on a tape. The balance of each account is to be updated. The old balance, the computed

interest, and the new balance are to be printed on a customer statement.

Solution:



Example 3:

Draw a program flow-chart to calculate the total commission for 100 salesmen according to the following information: Counter of salesmen = N

Total commission accumulator = Sum

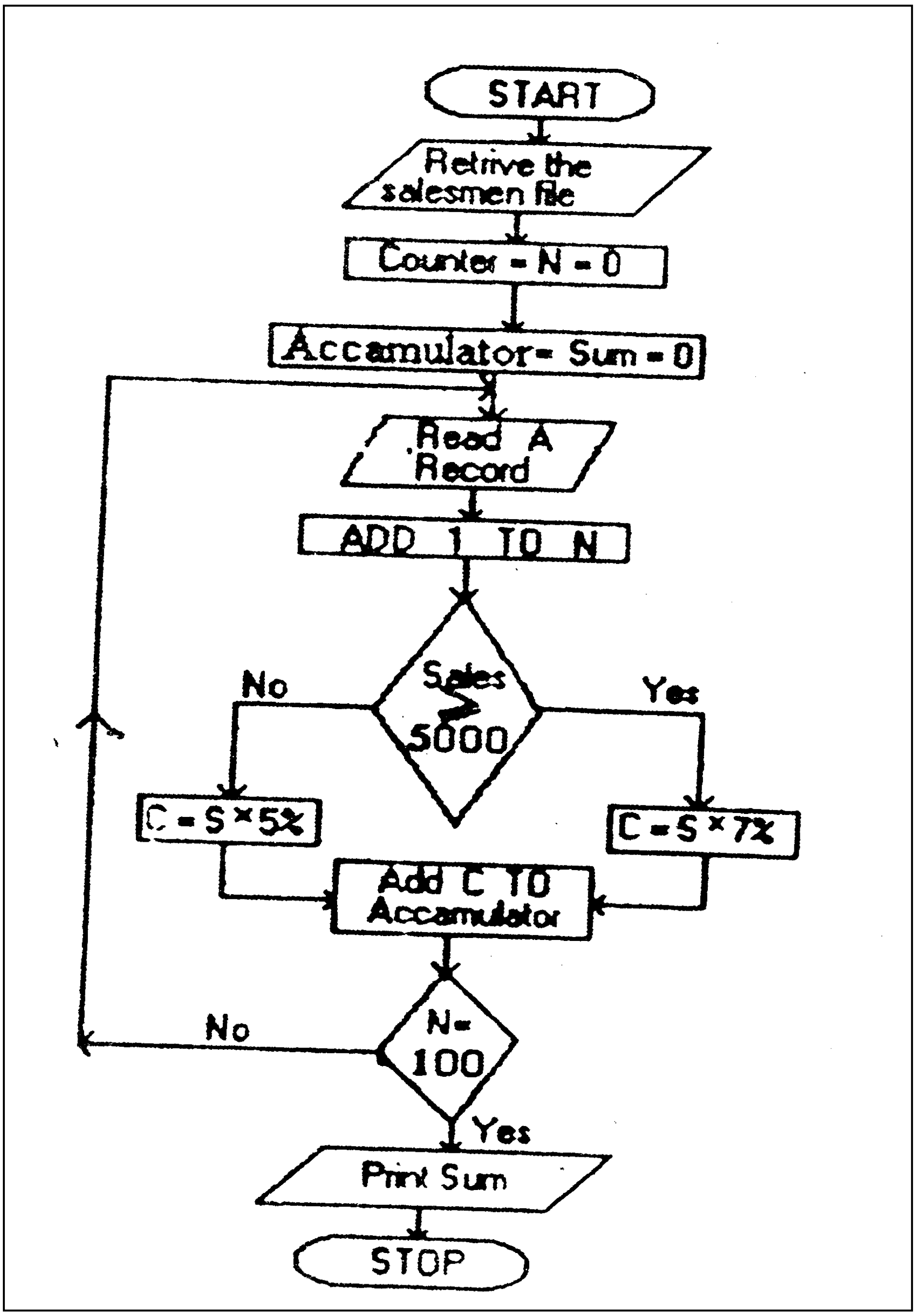
Sales amount = S

Commission = C

Commission would be calculated according to the following rule:

Commission (C) = 7% if sales (S) is > L.E. 5000.

Commission (C) = 5% if sales (S) is < L.E. 5000.


START
Retrive the salesmen file
Counter = N = 0
Accamulator= Sum = 0
Read A Record
ADD 1 TO N
Sales ≥ 5000
No
Yes
C = S × 5%
C = S × 7%
Add C TO Accamulator
N= 100
No
Yes
Print Sum
STOP

9.2.3. Coding the Program:

As the programmer, your next step is to code the program--that is, to express your solution in a programming language. You will translate the logic from the flowchart or pseudo code or some other tool to a programming language. *There are many programming languages: BASIC, COBOL, Pascal, FORTRAN, and C* are some examples.

Although programming languages operate grammatically, somewhat like the English language, they are much more precise. To get your program to work, you have to follow exactly the rules--the *syntax*--of the language you are using. Of course, using the language correctly is no guarantee that your program will work, any more than speaking grammatically correct English means you know what you are talking about. The point is that correct use of the language is the

required first step. Then your coded program must be keyed, probably using a terminal or personal computer, in a form the computer can understood.

One more note here: Programmers usually use a *text editor*, which is somewhat like a word processing program, to create a file that contains the program. However, as a beginner, you will probably want to write your program code on paper first.

9.2.4. Testing the Program:

After coding the program, you must prepare to test it on the computer. This step involves these phases:

Desk- checking:

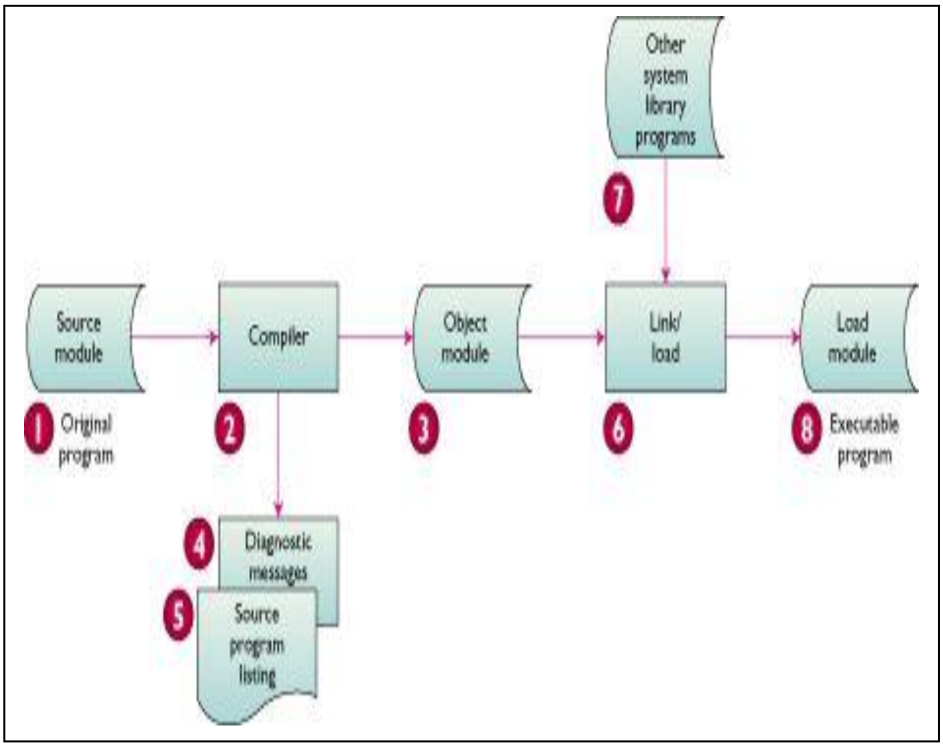
In desk-checking you simply sit down and mentally trace, or check, the logic of the program to attempt to ensure that it is error-free and workable.

Translating:

A *translator* is a program that (1) *checks the syntax of your program to make sure the programming language was used correctly, gives you syntax-error messages, called diagnostics*, and then (2) *translates your program into a form the computer can understand*. The mistakes are called ***syntax errors***. The translator produces descriptive error messages.

Debugging :

A term used extensively in programming, *debugging* means *detecting, locating, and correcting bugs (mistakes), usually by running the program.* In the debugging phase you run the program using test data that you devise. You must plan the test data carefully to make sure you test every part of the program.



Preparing a program for execution

9.2.5. Documenting the Program:

Documentation *is a written detailed description of the programming cycle and specific facts about the program.* Typical program documentation materials *include* the *origin and nature of the problem, a brief*

narrative description of the program, logic tools such as flowcharts and pseudo code, data-record descriptions, program listings, and testing results. Comments in the program itself are also considered an essential part of documentation.

9.3. PROGRAMMING LANGUAGES:

There are several languages in common use today, before we turn to specific languages, however, we need to discuss levels of language. Programming languages are said to be "lower" or "higher," depending on how close they are to the language the computer itself uses (0s and 1s--low) or to the language people use (more English-like--high). There are ***five levels of language***, numbered 1 through 5 to correspond to levels, or generations. In terms of ease of use and capabilities, each generation is an improvement over its predecessors.

The five generations of languages are

(1) Machine language,

(2) Assembly languages,

(3) High-level languages,

(4) Very high level languages, and

(5) Natural languages.

Note the time -line for the language generations in Figure (9-4) .Let us look at each of these categories.

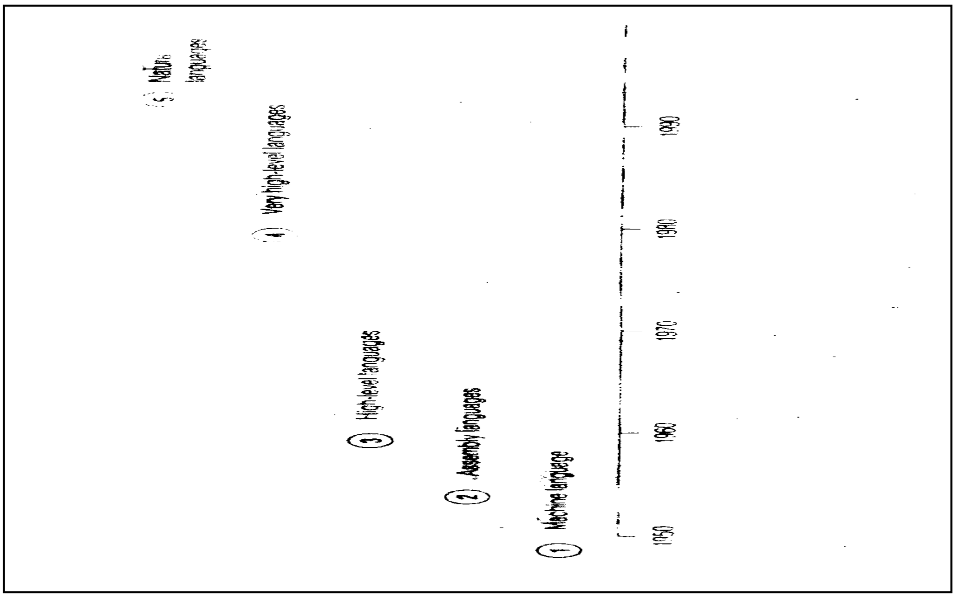


FIGURE (9-4) Language generation on a timeline

9.3.1.Machine Language:

This lowest level of language, machine language, represents data and program instructions as Is and Os-binary digits corresponding to the on and off electrical states in the computer. This is really the only language the computer truly understands; all other languages must be translated to the machine language before execution.

Machine language is a language taken from a mainframe computer. Each type of computer has its own machine language. In the early days of computing, programmers had rudimentary systems for combining numbers to represent instructions such as add and compare. Primitive by today's standards, the programs were not convenient for people to read and use. The

computer industry quickly moved to develop assembly language.

Machine language

FD	71	431F	4153
F3	63	4267	4321
96	F0	426D	
F9	10	41F3	438A
47	40	40DA	
47	F0	4050	

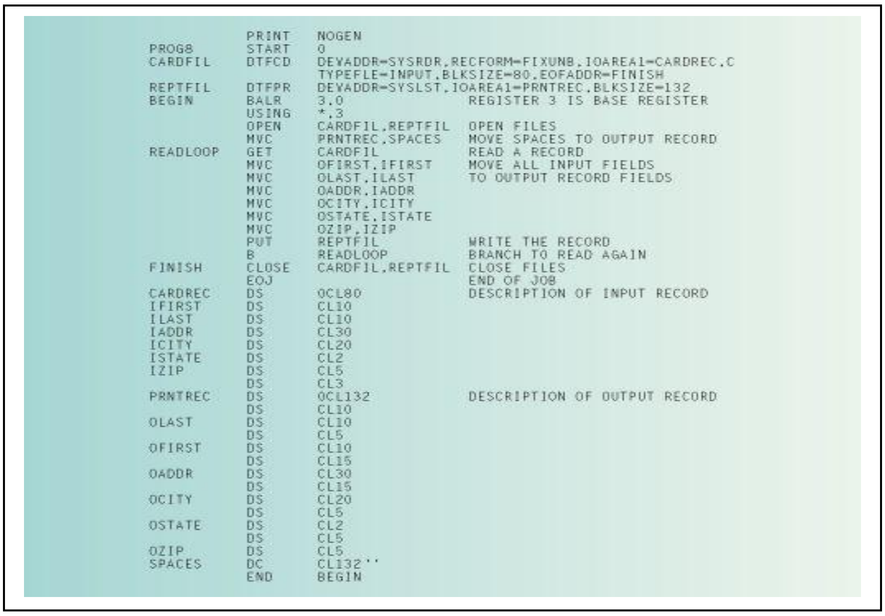
9.3.2.Assembly Languages:

Today, ***assembly languages*** are considered *very low level*-that is, they are not as convenient for people to use as more recent languages. At the time they were developed, however, they were considered a great leap forward. *To replace the Is and Os used in*

*machine language, assembly languages use **mnemonic codes**, abbreviation that are easy to remember*: *A for Add*, *C for Compare*, *MP for Multiply*, *STO for storing information in memory*, and so on, Although these codes are not English words, they are still-from the standpoint of human convenience-preferable to numbers (Os and Is) alone. Furthermore, assembly languages permit the use of names-perhaps RATE or TOTAL-for memory locations instead of actual address numbers. Just like machine language, each type of computer has its own assembly language.

*The programmer who uses an assembly language requires a **translator** to convert the assembly language program into machine language.* A translator is needed because machine language is the only language the computer can

actually execute. The ***translator*** is ***an Assembler program***, also referred to as an assembler. It takes the program written in assembly language and turns them into machine language. Programmers need not worry about the translating aspect; they need only write programs in assembly language. The translation is taken care of by the assembler. Assembly language may be easier to read than machine language, but it is still tedious.



```
          PRINT   NOGEN
PROG8     START   0
CARDFIL   DTFCD   DEVADDR=SYSRDR,RECFORM=FIXUNB,IOAREA1=CARDREC,C
                  TYPEFLE=INPUT,BLKSIZE=80,EOFADDR=FINISH
REPTFIL   DTFPR   DEVADDR=SYSLST,IOAREA1=PRNTREC,BLKSIZE=132
BEGIN     BALR    3,0              REGISTER 3 IS BASE REGISTER
          USING   *,3
          OPEN    CARDFIL,REPTFIL  OPEN FILES
          MVC     PRNTREC,SPACES   MOVE SPACES TO OUTPUT RECORD
READLOOP  GET     CARDFIL          READ A RECORD
          MVC     OFIRST,IFIRST    MOVE ALL INPUT FIELDS
          MVC     OLAST,ILAST      TO OUTPUT RECORD FIELDS
          MVC     OADDR,IADDR
          MVC     OCITY,ICITY
          MVC     OSTATE,ISTATE
          MVC     OZIP,IZIP
          PUT     REPTFIL          WRITE THE RECORD
          B       READLOOP         BRANCH TO READ AGAIN
FINISH    CLOSE   CARDFIL,REPTFIL  CLOSE FILES
          EOJ                      END OF JOB
CARDREC   DS      0CL80            DESCRIPTION OF INPUT RECORD
IFIRST    DS      CL10
ILAST     DS      CL10
IADDR     DS      CL30
ICITY     DS      CL20
ISTATE    DS      CL2
IZIP      DS      CL5
          DS      CL3
PRNTREC   DS      0CL132           DESCRIPTION OF OUTPUT RECORD
          DS      CL10
OLAST     DS      CL10
          DS      CL5
OFIRST    DS      CL10
          DS      CL15
OADDR     DS      CL30
          DS      CL15
OCITY     DS      CL20
          DS      CL5
OSTATE    DS      CL2
          DS      CL5
OZIP      DS      CL5
SPACES    DC      CL132''
          END     BEGIN
```

Assembly language

9.3.3. High-Level Languages:

The first widespread use of ***high-level languages*** in the early 1960s transformed programming into something quite different from what it had been. Programs were written in an English-like manner, thus making them more convenient to use. As a result, a programmer could accomplish more with less effort, and programs could now direct much more complex tasks. Of course, a ***translator*** is *needed to translate the symbolic statements of a high-level language into computer-executable machine language*; this ***translator is usually a Compiler.*** There are many compilers for each language and at least one for each type of computer.

9.3.3.1. FORTRAN: HIGH-level Language:

Developed by IBM and introduced in 1954, ***FORTRAN***--for ***FOR*** mula ***TRAN*** slator--was the first high-level language. *FORTRAN is a scientifically oriented language*; in the early days, use of the computer was primarily associated with engineering, mathematical, and scientific research tasks. FORTRAN is noted for its brevity, and this characteristic is part of the reason it remains popular. *This language is very good at serving its primary purpose, which is the execution of complex formulas such as those used in economic analysis and engineering.*

```
C      FORTRAN PROGRAM
C      AVERAGING INTEGERS ENTERED THROUGH THE KEYBOARD
       WRITE (6,10)
       SUM = 0
       COUNTER = 0
       WRITE (6,60)
       READ (5,40) NUMBER
  1    IF (NUMBER .EQ. 999) GOTO 2
       SUM = SUM + NUMBER
       COUNTER = COUNTER + 1
       WRITE (6,70)
       READ (5,40) NUMBER
       GO TO 1
  2    AVERAGE = SUM / COUNTER
       WRITE (6,80) AVERAGE
 10    FORMAT (1X, 'THIS PROGRAM WILL FIND THE AVERAGE OF',
     * 'INTEGERS YOU ENTER ',/1X, 'THROUGH THE ',
     *  'KEYBOARD. TYPE 999 TO INDICATE END OF DATA.',/)
 40    FORMAT (I3)
 60    FORMAT (1X, 'PLEASE ENTER A NUMBER ')
 70    FORMAT (1X, 'PLEASE ENTER THE NEXT NUMBER ')
 80    FORMAT (1X, 'THE AVERAGE OF THE NUMBERS IS ',F6.2)
       STOP
       END
```

(a)

```
THIS PROGRAM WILL FIND THE AVERAGE OF INTEGERS YOU ENTER
THROUGH THE KEYBOARD.  TYPE 999 TO INDICATE END OF DATA.
PLEASE ENTER A NUMBER    6
PLEASE ENTER THE NEXT NUMBER      4
PLEASE ENTER THE NEXT NUMBER     11
PLEASE ENTER THE NEXT NUMBER    999
THE AVERAGE OF THE NUMBERS IS      7.00
```

(b)

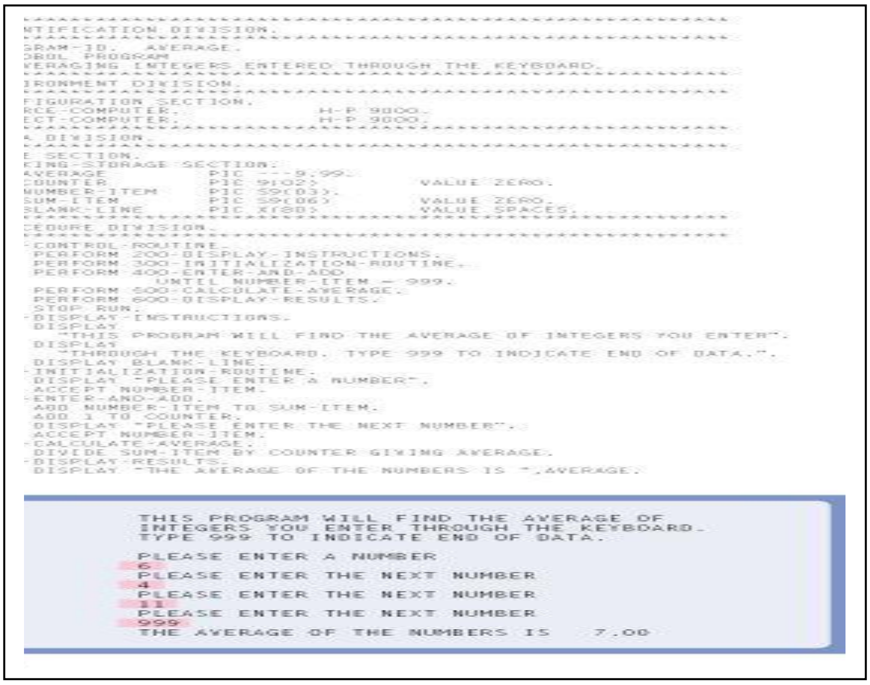
FORTRAN program and sample output

9.3. 3. 2. COBOL: The Language of Business:

By the mid-1950s FORTRAN had been developed, but there was still no accepted high-level programming language appropriate for business. The U.S. Department of Defense in particular was interested in creating such a standardized language

and called together a committee that, in 1959, introduced ***COBOL***, for ***CO****mmon* ***B****usiness-* ***O****riented* ***L****anguage.*

COBOL is very good for processing large files and performing relatively simple business calculations, such as payroll or interest. COBOL is English-like; even if you know nothing about programming, you may still understand what the program does.



```
NTIFICATION DIVISION.
GRAM-ID.   AVERAGE.
OBOL PROGRAM
VERAGING INTEGERS ENTERED THROUGH THE KEYBOARD.
IRONMENT DIVISION.
FIGURATION SECTION.
RCE-COMPUTER.            H-P 9000.
ECT-COMPUTER.            H-P 9000.
A DIVISION.
E SECTION.
KING-STORAGE SECTION.
AVERAGE          PIC ---9.99.
COUNTER          PIC 9(02)         VALUE ZERO.
NUMBER-ITEM      PIC S9(03).
SUM-ITEM         PIC S9(06)        VALUE ZERO.
BLANK-LINE       PIC X(80)         VALUE SPACES.
CEDURE DIVISION.
-CONTROL-ROUTINE.
 PERFORM 200-DISPLAY-INSTRUCTIONS.
 PERFORM 300-INITIALIZATION-ROUTINE.
 PERFORM 400-ENTER-AND-ADD
        UNTIL NUMBER-ITEM = 999.
 PERFORM 500-CALCULATE-AVERAGE.
 PERFORM 600-DISPLAY-RESULTS.
 STOP RUN.
-DISPLAY-INSTRUCTIONS.
 DISPLAY
   "THIS PROGRAM WILL FIND THE AVERAGE OF INTEGERS YOU ENTER".
 DISPLAY
   "THROUGH THE KEYBOARD. TYPE 999 TO INDICATE END OF DATA.".
 DISPLAY BLANK-LINE.
-INITIALIZATION-ROUTINE.
 DISPLAY "PLEASE ENTER A NUMBER".
 ACCEPT NUMBER-ITEM.
-ENTER-AND-ADD.
 ADD NUMBER-ITEM TO SUM-ITEM.
 ADD 1 TO COUNTER.
 DISPLAY "PLEASE ENTER THE NEXT NUMBER".
 ACCEPT NUMBER-ITEM.
-CALCULATE-AVERAGE.
 DIVIDE SUM-ITEM BY COUNTER GIVING AVERAGE.
-DISPLAY-RESULTS.
 DISPLAY "THE AVERAGE OF THE NUMBERS IS ",AVERAGE.
```

```
THIS PROGRAM WILL FIND THE AVERAGE OF
INTEGERS YOU ENTER THROUGH THE KEYBOARD.
TYPE 999 TO INDICATE END OF DATA.

PLEASE ENTER A NUMBER
6
PLEASE ENTER THE NEXT NUMBER
4
PLEASE ENTER THE NEXT NUMBER
11
PLEASE ENTER THE NEXT NUMBER
999
THE AVERAGE OF THE NUMBERS IS   7.00
```

COBOL program and sample output

9.3.3.3. BASIC: For Beginners and Others:

BASIC--**B**eginners' ***A****ll-purpose* ***S****ymbolic* ***I****nstruction* ***C****ode*--is a common language that is easy to learn even for a person who has never programmed before. The use of ***BASIC*** has extended to business and personal computer systems. BASIC is also used by non-programming people, such as engineers, who find it useful in problem solving for many years.

```
'BASIC PROGRAM
'AVERAGING INTEGERS ENTERED THROUGH THE KEYBOARD
CLS
PRINT "THIS PROGRAM WILL FIND THE AVERAGE OF INTEGERS YOU ENTER"
PRINT "THROUGH THE KEYBOARD. TYPE 999 TO INDICATE END OF DATA."
PRINT
SUM=0
COUNTER=0
PRINT "PLEASE ENTER A NUMBER"
INPUT NUMBER
DO WHILE NUMBER <> 999
     SUM=SUM+NUMBER
     COUNTER=COUNTER+1
     PRINT "PLEASE ENTER THE NEXT NUMBER"
     INPUT NUMBER
LOOP
AVERAGE=SUM/COUNTER
PRINT "THE AVERAGE OF THE NUMBERS IS": AVERAGE
END
```

(a)

```
THIS PROGRAM WILL FIND THE AVERAGE OF INTEGERS YOU ENTER
THROUGH THE KEYBOARD. TYPE 999 TO INDICATE END OF DATA.

PLEASE ENTER A NUMBER
?6
PLEASE ENTER THE NEXT NUMBER
?4
PLEASE ENTER THE NEXT NUMBER
?11
PLEASE ENTER THE NEXT NUMBER
?999
THE AVERAGE OF THE NUMBERS IS   7
```

9.3.4. Very High-Level Languages:

Languages called ***very high-level languages*** are often known by their *generation number*, that is, they are called *fourth-generation languages* or, more simply, ***4GLs***.

An operation that requires hundreds of lines in a third-generation language typically requires only 5 to 10 lines in a 4GL. 4GLs are difficult to describe because there are so many different types. The 4GLs are essentially shorthand programming languages. A variation on fourth-generation languages is ***query languages***, which can be used to retrieve information from *databases*. Data is usually added to databases according to a plan, and planned reports may also be produced. But what about a user who needs an unscheduled report or a report that differs somehow from the standard reports? A user can

learn a query language fairly easily and then request and receive the resulting report on his or her own terminal or personal computer. A standardized query language, which can be used with several different commercial database programs, is ***Structured Query Language (SQL).***

9.3.5. Natural Languages:

The newest level of languages, called ***fifth-generation languages***, is even more ill-defined than fourth-generation languages. They are most often called ***Natural Languages*** because of their resemblance to the "natural" spoken English language; that is, they resemble the way that you speak. *A user of one of these languages can say the same thing in any number of ways.*

<u>A natural language</u>

Chapter (10)
SPREADSHEETS
AND
BUSINESS GRAPHICS

10.1. The nature of spreadsheet.

10.2. Spreadsheet fundamentals.

10.3. Spreadsheet features

10.4. A problem for a spreadsheet

10.5. Business graphics

LEARNING OBJECTIVES

- **Appreciate the advantage of spreadsheets.**
- **Be aware of the types of applications for spreadsheets.**
- **Understand the underlying principles of the electronic spreadsheets use**

A spreadsheet package is a computer program created specifically to help in the processing of tabular information, usually numbers. The spreadsheet stores information in rows (across the screen) and columns (down the screen), forming a worksheet *(the Excel term for a spreadsheet).* Spreadsheets are most commonly used to manipulate figures. They can be used for accounting, cash flows, budgeting, forecasts, etc. Any job that involves the use of numbers can be done on a spreadsheet. The biggest *advantage* that a spreadsheet has over other methods of manipulating data is its ability to constantly update figures without the user having to do any calculations. Once a spreadsheet is set up, its calculations will always be correct and any changes in data are automatically updated. Spreadsheets can also take raw data and present it

in an attractive way, with formatted tables and graphs.

10.1. The Nature of Spreadsheets

A worksheet that presents data in a grid of rows and columns is called a ***spreadsheet*** (Figure1).The manually constructed spreadsheet, on paper, has been used as a business tool for centuries. Spreadsheets can be used to *organize and present business data, thus aiding managerial decisions*. However, spreadsheets are not limited to businesses. Personal and family budgets, for example, are often organized on spreadsheets. Furthermore, nonfinancial or even nonnumeric data can be presented and analyzed in a spreadsheet format.

	JAN.	FEB.	MAR.	APR.	TOTAL
SALES	1750	1501	1519	1430	6200
COST OF GOODS SOLD	964	980	932	943	3819
GROSS MARGIN	786	521	587	487	2381
NET EXPENSE	98	93	82	110	383
ADM EXPENSE	77	79	69	88	313
MISC EXPENSE	28	45	31	31	135
TOTAL EXPENSES	203	217	182	229	831
AVERAGE EXPENSE	68	72	61	76	277
NET BEFORE TAXES	583	304	405	258	1550
FEDERAL TAXES	303	158	211	134	806
NET AFTER TAX	280	146	194	124	744

(a)

(Figure 1)

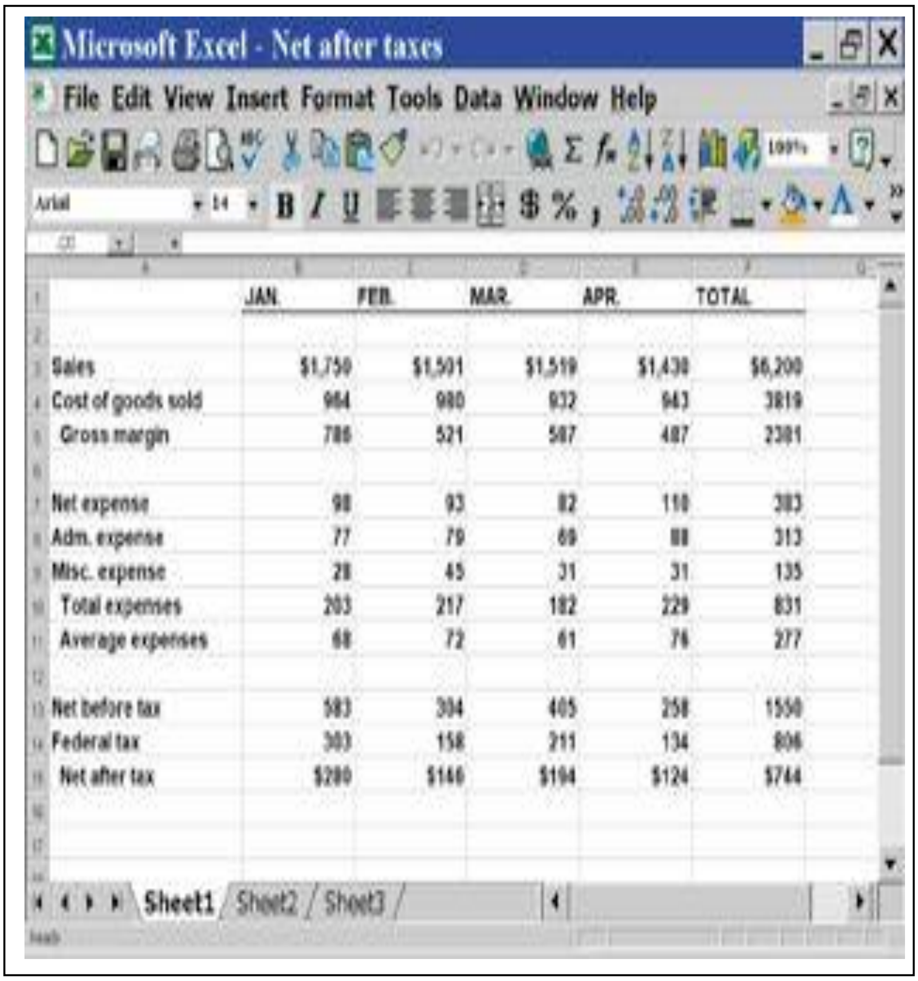
Unfortunately, creating a large spreadsheet manually is time-consuming and tedious, even when you use a calculator or copy results from a computer printout. Another problem with manual spreadsheets is that making a mistake is too easy.

If you do not discover the mistake, the consequences can be serious. If you discover the mistake after the spreadsheet is finished, you must manually redo all the calculations that used the wrong number.

10.1.1 Electronic Spreadsheets

An Electronic Spreadsheet, or Worksheet, is a *computerized version of a paper spreadsheet* (Figure 2) Working with a spreadsheet on a computer eliminates much of the toil of setting up a manual spreadsheet. In general, an electronic spreadsheet works like this: You enter the data you want on your spreadsheet and then key in the types of calculations you need. The electronic spreadsheet program automatically does all the calculations for you, completely error-free, and produces the results in your spreadsheet. You can

print a copy of the spreadsheet and store the data on your disk so that the spreadsheet can be used again.



(Figure 2)

By far the greatest labor-saving aspect of the electronic spreadsheet is ***automatic recalculation*****:** When you change one value or calculation on your spreadsheet, all dependent values on the spreadsheet are automatically recalculated to reflect the change. Suppose, to use a common example, that one entry on a spreadsheet is RATE, another is HOURS, and another is SALARY, which is the product of RATE and HOURS. Values for RATE and HOURS will be entered, but SALARY will be calculated by the spreadsheet software. But what if RATE changes? RATE can be entered anew, but the person entering the data need not worry about SALARY because the spreadsheet will recalculate SALARY using the new value for RATE. Although this example may seem trivial, the automatic recalculation principle has

significant consequences for large, complex spreadsheets. A change in a single value could affect dozens or even hundreds of calculations, which, happily, the spreadsheet will perform.

10.1.2. "What-If" Analysis"

Automatic recalculation is valuable for more than just fixing mistakes. If a number is changed--not because it is incorrect but because a user wants to see different results--related calculations will also be changed at the same time. This ability to change a number and have the change automatically reflected throughout the spreadsheet is the foundation of ***"What-If" Analysis-***-the process of changing one or more spreadsheet values and observing the resulting calculated effect. Consider these examples:

- What if a soap manufacturer was to reduce the price of a certain brand by 5 percent; how would the net profit be affected? How about 10 percent? 15 percent?
- What if a general contractor was to subcontract with several workers, but one of them reneged and the contractor had to hire someone more expensive; how would that affect the total cost?
- What if the prime lending rate was raised or lowered; how would these affect interest moneys for the bank or the cost of a loan for bank customers?

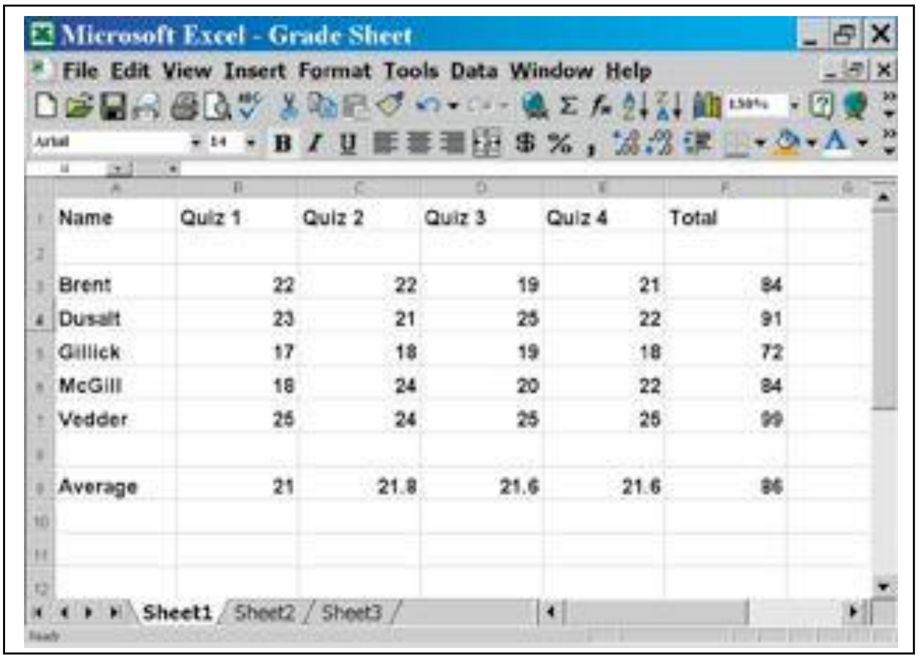
Once the initial spreadsheet is set up, any of these *"what-if"* scenarios can be answered by changing one value and examining the new, recalculated results.

10.2. Spreadsheet Fundamentals

Before you can learn how to use a spreadsheet, you must understand some basic spreadsheet features. The characteristics and definitions that follow are common to all spreadsheet programs.

10.2.1. Cells and Cell Addresses

Figure 3 shows one type of spreadsheet--a teacher's grade sheet. Notice that the spreadsheet is divided into rows (horizontal) and columns (vertical). ***The rows have numeric labels and the columns have alphabetic labels.*** There are actually more rows and columns than you can see on the screen. Some spreadsheets have thousands of rows and hundreds of columns--probably more than you will ever need to use.


Microsoft Excel - Grade Sheet
File Edit View Insert Format Tools Data Window Help
Name Quiz 1 Quiz 2 Quiz 3 Quiz 4 Total
Brent 22 22 19 21 84
Dusalt 23 21 25 22 91
Gillick 17 18 19 18 72
McGill 18 24 20 22 84
Vedder 25 24 25 25 99
Average 21 21.8 21.6 21.6 86
Sheet1 Sheet2 Sheet3

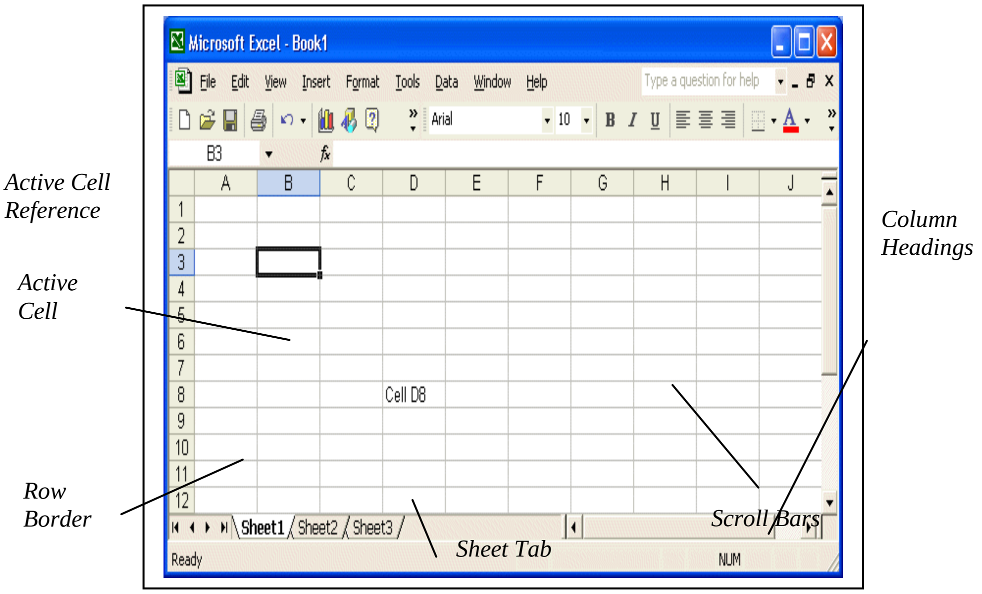

Active Cell Reference
Active Cell
Row Border
Column Headings
Microsoft Excel - Book1
File Edit View Insert Format Tools Data Window Help
Type a question for help
B3
Cell D8
Sheet1 Sheet2 Sheet3
Sheet Tab
Scroll Bars
Ready
NUM

Figure 3

The intersection of a row and column forms a ***cell***. A ***Cell*** *is a storage area on a spreadsheet*. When referring to a cell, you use the letter and number of the intersecting column and row. For example, in Figure 3, cell *B7* is the intersection of column *B* and row *7*--the grade of 25 for Vender on Quiz 1. This reference name is known as the ***Cell Address, or Cell Reference***. Notice that the alphabetic column designation always precedes the row number: B7, not 7B. On a spreadsheet one cell is always known as the ***Active Cell, or Current Cell***. When a cell is active you can enter data or edit that cell's contents. Typically, the active cell is marked by highlighting in reverse video or with a heavy border drawn around it. The active cell in Figure 3 is cell A1. You can use a mouse or the cursor-movement (arrow)

keys to scroll through a spreadsheet both vertically and horizontally.

10.2.2. Contents of Cells: Labels, Values, and Formulas

Each cell can contain one of *three types of information:* a ***Label, a Value, or a Formula***. A ***label*** *provides descriptive text information about entries in the spreadsheet, such as a person's name. A cell that contains a label is not generally used to perform mathematical calculations.* For example, in Figure 3, cells A1, A9, and F1, among others, contain labels. A ***value*** *is an actual number entered into a cell to be used in calculations*. In Figure 3, for example, cell B3 contains a value. A ***formula*** is *an instruction to the program to calculate a number*. A formula generally contains cell addresses and one or more

arithmetic operators: a plus sign (+) to add, a minus sign (-) to subtract, an asterisk (*) to multiply, and a slash (/) to divide. When you use a formula rather than entering the calculated result, the software can automatically recalculate the result if you need to change any of the values on which the formula is based. In addition to the types of calculations just mentioned, a formula can include one or more functions. ***A function*** is like a preprogrammed formula. ***Two*** common functions are the ***SUM*** function, which adds numbers together, and the ***AVG*** function, which calculates the average of a group of numbers. Most spreadsheet programs contain many functions for a variety of uses, from mathematics to statistics to financial applications. A ***formula*** or function does not appear in the cell; instead, the cell shows the result of the formula or

function. The result is called the ***displayed value*** of the cell. The formula or function is the ***content*** of the cell.

10.2.3. Ranges

Sometimes it is necessary to specify a range of cells in order to build a formula or perform a function. ***A Range*** *is a group of one or more adjacent cells occurring in a rectangular shape*; the program treats the range as a unit during an operation. Figure 4 shows some ranges. To define a range, you must indicate the upper-left and lower-right cells of the block. Depending on the particular spreadsheet software you are using, the cell addresses are separated by a colon or by two periods. For example, in Figure 2, the Quiz 1 range is B3:B7 (or B3..B7), and the Brent quiz range is B3:E3 (or B3..E3).

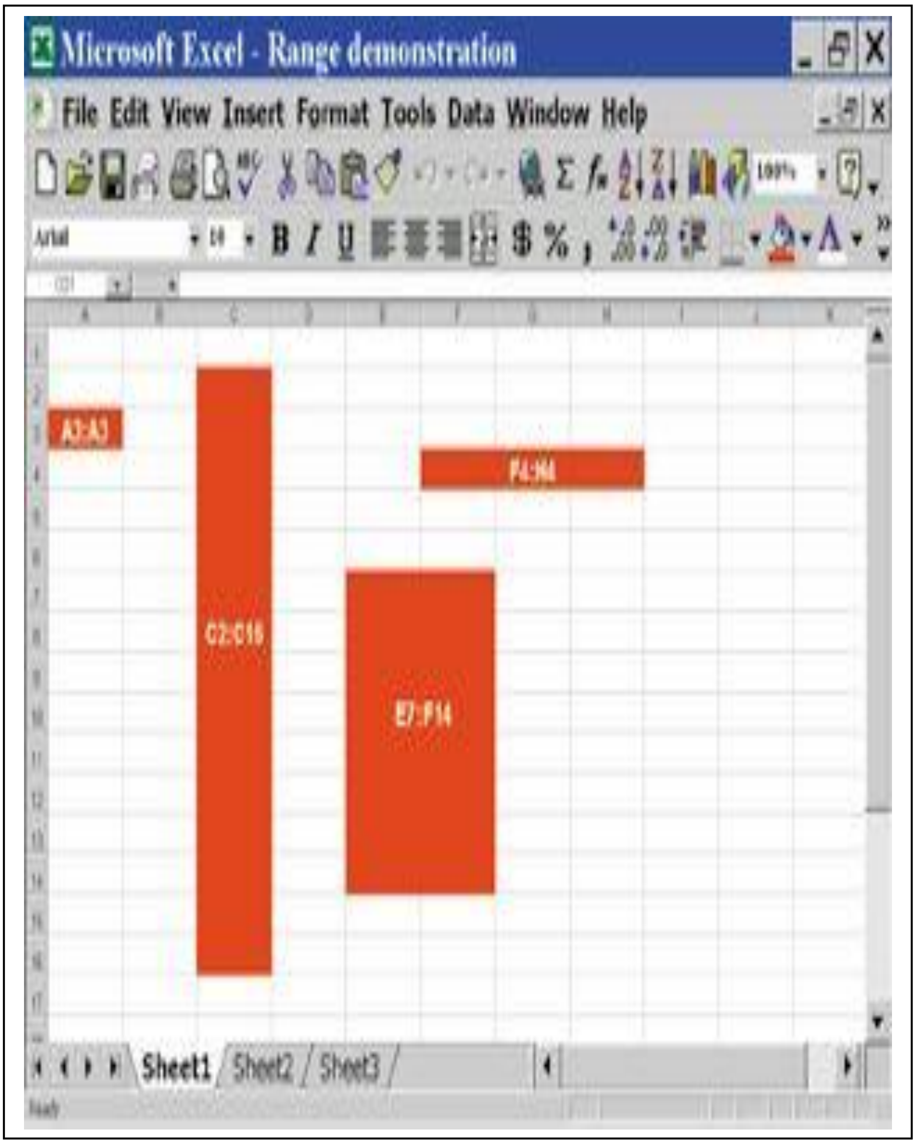

Microsoft Excel - Range demonstration
File Edit View Insert Format Tools Data Window Help
A3:A3
C2:C16
F4:H4
E7:F14
Sheet1
Sheet2
Sheet3

Figure 4

10.3. Spreadsheet Features

Once spreadsheet users master the basics, they are usually eager to learn the extra features, especially formatting and graphics, that make their work more useful or attractive. Formatting features take a worksheet beyond the historically plain page full of numbers. Here is a partial list of features you will probably find included with spreadsheet software:

***Column width*.** Columns containing labels--words--usually need to be wider than columns for numbers. Columns can also be made narrower. (Incidentally, although less common, it is also possible to alter the height of a row.)

Headings If a heading is desired, it can be invoked as a wide column and can even be centered.

Number Symbols If appropriate, a number value can be shown with a dollar sign (L.E.), a percent sign (%), and commas and decimal places, as desired.

Appearance Of Data Spreadsheet data can be presented in one of many proffered fonts and in boldface or italic. Furthermore, data can be centered within the cell or can be justified right or left within the cell. Often an entire column of cells will be justified right or left.

Printing When a user is developing and experimenting with a spreadsheet, he or she is looking at the spreadsheet on the screen. But the finished product, or even a series of variations of the product, will probably be printed for distribution and examination. Spreadsheet software offers several printing options. For example, a spreadsheet may be centered on the

printed page. Margins may be altered. The entire page may be printed sideways, that is, horizontally instead of vertically. Vertical and horizontal grid lines may be hidden on the printed spreadsheet**.**

Decoration Many spreadsheet packages include decorative features, such as borders and color options. The change from numbers to pictures--graphics--is a refreshing variation. Most spreadsheet software makes it fairly easy to switch from numbers to pictures. That is, once you prepare a spreadsheet, you can show your results in graphic form. The value of business graphics will be discussed in detail later in the chapter.

10.4. A Problem for a Spreadsheet

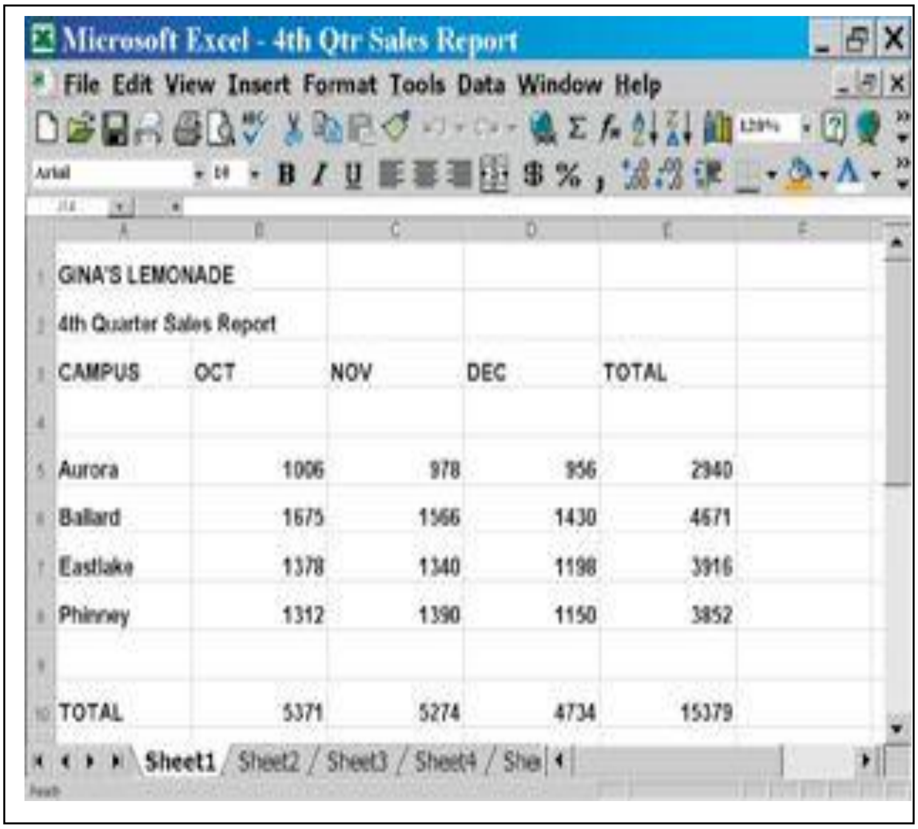
AHMED was an entrepreneur. One hot summer day he borrowed some sugar and lemons from the kitchen and stirred up a pitcher of lemonade, which he proceeded to sell from a stand in front of his house. In the process, he learned that it was important to keep good business records.

10.4.1. A New Business

When AHMED attended College, he noticed that the only beverages available were milk, coffee, and canned soft drinks. Thinking back to his early days, AHMED got permission to set up a lemonade stand on campus. In addition to fresh lemonade, he sold bagels and homemade cookies. The stand was soon successful, and eventually AHMED hired other students to manage stands on nearby campuses: X, Y, and Z.

10.4.2. Using Spreadsheets for the Business

When AHMED took a computer applications course at the college, he decided that spreadsheets were appropriate for keeping track of his business. He began by comparing sales for the four campuses for the fourth quarter of the year. As he invoked the spreadsheet software, AHMED decided that he also would add some headings. In his first cut at the spreadsheet, AHMED keyed in the campus names in column A and the campus sales for each of the three months in columns B, C, and D.



(Figure 5)

AHMED does not, of course, have to compute totals--the spreadsheet software will do that. In fact, the obvious solution is to key formulas using the SUM function to compute both column and row totals. In cell E6, for example, AHMED keys =SUM (B6:D6). This

instructs the software to sum the values in cells B6, C6, and D6 and place the resulting sum in cell E6. Even though he typed a formula in the cell, the result is a value, in this case 4671 *(Figure 5)*. Keep in mind that the resulting value in any cell containing a formula will change if any of the values in the cells in the formula change. For cell E6 the resulting value would change if there was a change to the values in cell B6, C6, or D6. The other cells containing totals (E5, E7, E8, B10, C10, D10, and E10) also contain formulas that will calculate values. Cell E10, by the way, could sum up either column E (=SUM (E5:E8)) or row 10 (=SUM (B10:D10)). The result is the same either way.

AHMED has been saving his spreadsheet on disk as he goes along. Now that the basic

spreadsheet is complete, AHMED saves it one more time and then prints it.

10.4.3. Changing the Spreadsheet: Automatic Recalculation

AHMED has discovered an error in his spreadsheet: Cell D6, rather than containing 1430, should be 1502. Again using her spreadsheet software, he needs merely to retrieve the spreadsheet from disk and make the single change to cell D6 *(Figure 6)*. Note, however, that cell D6 is used for the totals calculations in cells E6 and D10. Furthermore, because either column E or row 10 is used to compute the final total in E10, either changed cell E6 or changed cell D10 will cause a change in the value calculated in cell E10. All these changes are made by the spreadsheet software automatically. Indeed, note

the changed values in cells E6, D10, and E10--all the result of a single change to cell D6.

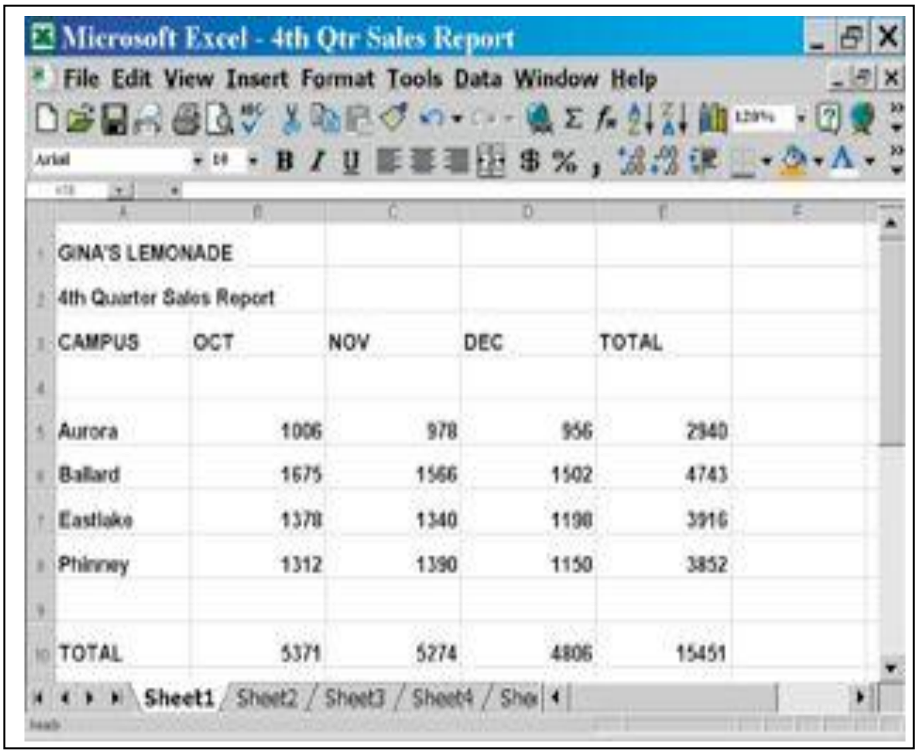


Figure 6 the altered spreadsheet, reflecting automatic recalculations.

10.4.4.Formatting and Printing

Now that AHMED is satisfied with his spreadsheet calculations, he decides to make some formatting changes and then print the

spreadsheet. He uses the spreadsheet software to make the changes (to see the changes, you can look ahead to Figure 7a). Here is a list of the changes she wants to make:

- Center the two major headings
- Use a different font on the two major headings and change them to boldface.
- Center CAMPUS, OCT, NOV, DEC, and both TOTAL labels, each within its own cell, and boldface each label.
- Put each campus name in italic
- Present the sales figures as currency by adding dollar signs (L.E.) and decimal points.
- Use a vertical double border to separate the campus names from the sales figures, a horizontal double border to separate the headings from the sales figures, and a single horizontal border to

separate the top two heading rows from the rest of the spreadsheet

- Remove the spreadsheet grid lines.

Note that the printed result need not include the alphabetic column labels or the numeric row labels (Figure 7a).

GINA'S LEMONADE
4th Quarter Sales Report

CAMPUS	OCT	NOV	DEC	TOTAL
Aurora	$ 1,006.00	$ 978.00	$ 956.00	$ 2,940.00
Ballard	$ 1,675.00	$ 1,566.00	$ 1,502.00	$ 4,743.00
Eastlake	$ 1,378.00	$ 1,340.00	$ 1,198.00	$ 3,916.00
Phinney	$ 1,312.00	$ 1,390.00	$ 1,150.00	$ 3,852.00
TOTAL	$ 5,371.00	$ 5,274.00	$ 4,806.00	$ 15,451.00

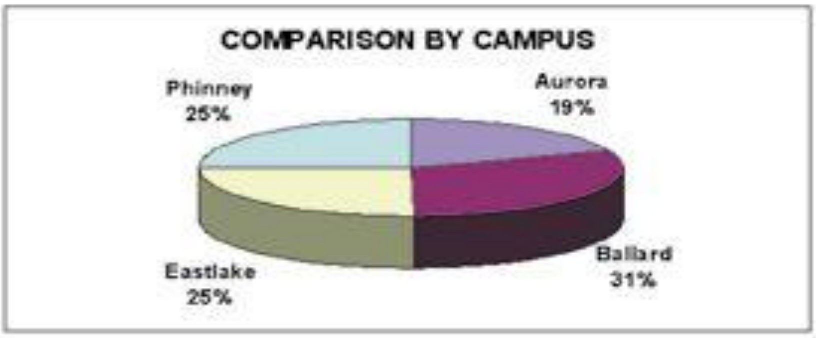


Figure 7 (a-b) The finished spreadsheet and a matching graph

10.4.5. A Graph from Spreadsheet Data

AHMED decides to make a chart to contrast the sales totals among the four campuses. These figures already exist in the last column of the spreadsheet, cells E5 through E8. Using the software's charting capability, AHMED can select those cells and then request a three-dimensional pie chart to display them. He decides to specify that the sales figures be shown as percentages of total sales and that each pie wedge be further labeled with the campus name, supplied from column A on the spreadsheet. After adding a title, Comparison by Campus, AHMED saves and prints the finished chart (Figure 7b).

10.5. Business Graphics

Graphics can show words and numbers and data in ways that are meaningful and quickly understood. This is the key reason they are valuable. Personal computers give people the capability to store and use data about their businesses. These same users, however, sometimes find it difficult to convey this information to others--managers or clients--in a meaningful way. ***Business Graphics***--graphics that represent data in a visual, easily understood format--provide an answer to this problem.

10.5.1. Why Use Graphics?

Graphics generate and sustain the interest of an audience by brightening up any lesson, report, or business document. In addition, graphics can help get a point across by presenting numeric data in one simple, clear graph. What is more,

that simple graph can reveal a trend that could be lost if buried in long columns of numbers. In addition, a presenter who uses graphics often appears more prepared and organized than one who does not. To sum up, most people use business graphics software for *two* reasons:

(1) *To view and analyze data and*

(2) *To make a positive impression during a presentation.*

To satisfy these different needs, ***Two*** types of business graphics programs have been developed: ***Analytical Graphics and Presentation Graphics.***

10.5.2. Analytical Graphics

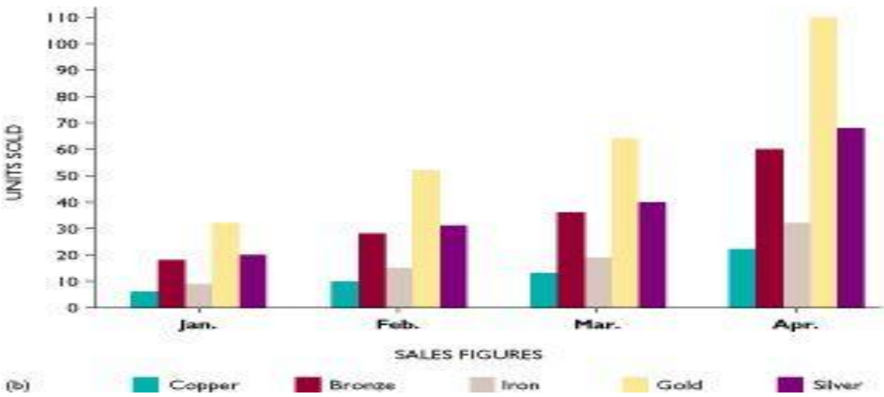
Analytical Graphics programs *are designed to help users analyze and understand specific data.* Sometimes called ***analysis-oriented graphics programs***, these programs use already-entered spreadsheet or database data to construct

and display ***Line, Bar, and Pie Chart*** graphs (Figure 8a through c). Spreadsheet software usually provides this option.

Although analytical graphics programs do a good job of producing simple graphs, these programs are too limited and inflexible for a user who needs to prepare elaborate presentations. Analytical graphics programs, for example, let you choose from only a small number of graph types, and the formatting features--graph size, color, and lettering--are limited. These restrictions may be of little concern to some users, but those who require sophisticated graphics will want to consider presentation graphics.

Material	Jan.	Feb.	Mar.	Apr.
	Units Sold Each Month			
Copper	6	10	13	22
Bronze	18	28	36	60
Iron	9	15	19	32
Gold	32	52	64	110
Silver	20	32	40	68
Totals:	85	137	172	292

(a)



(b)

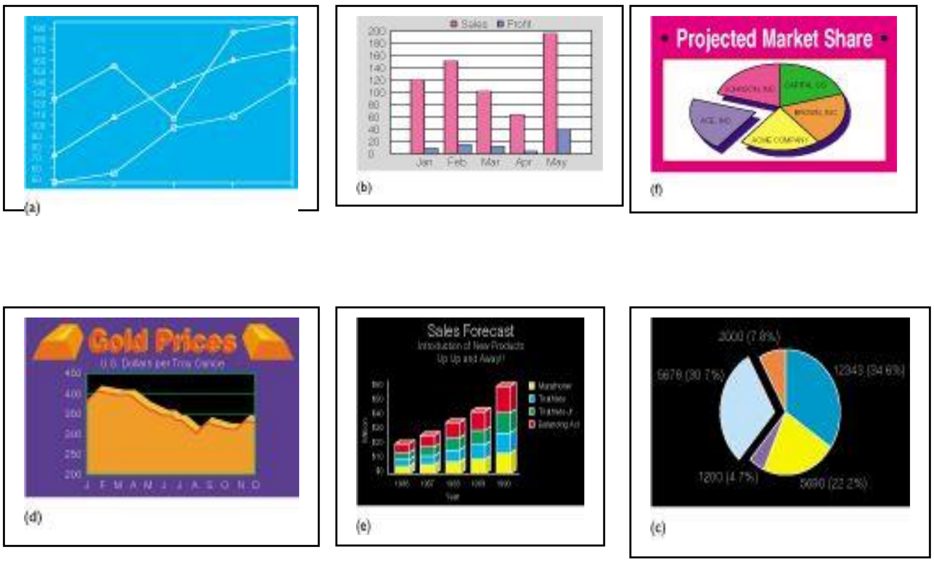


Figure 8 Analytical graphics compared with presentation graphics

10.5.3. Presentation Graphics

Presentation Graphics programs are also called ***Business-Quality Graphics***. These programs let you produce charts, graphs, and other visual aids that look as if they were prepared by a professional graphic artist (Figure 8 d through f). However, you can control the appearance of the product when you create it yourself, and you can produce graphics faster and make last-minute changes if necessary.

Most presentation graphics programs help you do several kinds of tasks:

- Edit and enhance charts, such as analytical graphs, created by other programs
- Create charts, diagrams, drawings, and text slides from scratch

- Use a library of symbols, drawings, and pictures called ***clip art*** that comes with the graphics program.
- Permit an animated presentation so that, for example, letters of a title can swoop in one by one to create a dynamic effect.
- Use small files that come with the program to add sounds--chimes, applause, swoosh, and even think--to your presentation.

Although graphics hardware requirements vary, be aware that to use presentation graphics you will need a high-resolution color monitor, possibly a color printer, and perhaps some method of transferring your computer-produced results to slides or transparencies or to a projector that can show computer screen output on a wall screen.

10.6. Some Graphics Terminology

To use a graphics program successfully, you should know some basic concepts and design principles. Let us begin by exploring the types of graphs you can create.

Line Graphs

One of the most useful ways of showing trends or cycles over a period of time is to use a ***line graph***. ***Line graphs*** are *used to show complex trends in gross national product, stock prices, or employment changes over a period of time*. Also, corporate profits and losses are often illustrated by line graphs.

Bar Graphs

Bar graphs are *used for graphing the same kinds of data that line graphs represent*. They are often used to illustrate multiple comparisons, such as sales, expenses, and production activities.

Pie Charts

Representing just a single value for each variable, a ***pie chart*** shows *how various values make up a whole. These charts really look like pies;* the whole amount is represented by a circle, and each wedge of the pie--a portion of the whole--represents a value

Pie charts can *show only the data for one time period, such as a single month*. However, of all the graphics, the pie chart does the best job of showing the proportions for different variables. If a pie chart for expenses, for example, showed that more than half went for rent, that half-pie is easy to spot.

Chapter (11)
DATA DASE MANAGEMENT SYSTEMS CONCEPTS, SOFTWARE, AND MODELS

LEARNING OBJECTIVES:

***- Define a data base.**

***- Trace the origin and history of data base systems.**

***- Define a data base management system (DBMS).**

***- Define DBMS software.**

***- Identify the components of DBMS software on a chart.**

***- Recognize the different types of query languages available at the moment.**

***- List the main functions of the utilities part of the DBMS.**

***- Define the data manipulation language (DML).**

***- Distinguish between the three data base models.**

11/1 : Introduction:

By the early 1970s, it was apparent that traditional file-handling concepts (as file management systems) were often no longer adequate to handle the large amounts of data and the sophisticated and complex informational needs of a business's computer-based Information system. To improve the quality of management information-and information for users in general - as well as the ease with which it could be produced, a new tool was developed: the “data base management system ".

In general, data base management concepts are the same for large computer systems and for microcomputers. As a general business user, you will most likely be using a microcomputer or a terminal to access data stored in a “data base ". A data base is a large group of stored, integrated

(cross - referenced) data elements that can be retrieved and manipulated with great flexibility to produce information. It is therefore important for you to understand not only what a data base is but also what a data base management system is, so that you can put them to effective use in your job . But, before we describe the data base management system (***DBMS***), we will first describe the traditional system it evolved from “the file management system"

11/2 File Management Systems :

File management systems used to be the only way of managing data and files . In these systems, data was stored in a series of unrelated files tape or disk.

The major ***problems*** associated with file management systems are:

(1) *Data redundancy* - the same data appears in more than one file.

(2) *Tedious updating procedures* because the same data appeared in many places, updating files were time consuming.

(3) *Poor data integrity* - if some redundant data elements were missed during file updating, they were no longer current and could cause inaccurate information to be produced.

(4) *Lack of data and program independence* - programmers could not use the data file to develop new programs because the data and the programs were restricted by existing formats.

To update either the application program or the data file became a major task. To deal with these problems and the ever - growing demands for a flexible, easy-to-use mechanism for

managing data, the concept of a data base was developed.

11/3 Data Base Management Systems :

A data base management system ***(DBMS)*** is a *comprehensive software tool that allows users to create, maintain, and manipulate an integrated base of business data to produce relevant management information*. By integrated we mean that records are logically related to one another so that all data on a topic can be retrieved by simple requests. In a *DBMS*, data needs to be entered into the system only once. When the user instructs the program to sort data or compile a list, the program searches quickly through the data in memory (or in storage), copying needed data into a new file for the purpose at hand. The user's instructions do not change the original set

of data in any way. (Data base administrators may change the data later when they update the data base.)

Data base management systems were developed to:

(1) *Make data independent of the applications programs being used*, so that it is easy to access and change.

(2) *Establish relationships among records in different files.* The user can obtain all data related to important data elements.

(3) *Eliminate data redundancy*. Because data is independent of the applications programs being used, it can be stored a single time in a file that can be accessed .

(4) *Define the characteristics of the data*. The user can create a data base that has data stored in it based on particular information needs.

(5) *Manage file access*. For example, the DBMS can “examine“ user requests and clear them for access to retrieve data , thus maintaining data safe from unauthorized access .

(6) *Maintain data integrity*. Because data is not stored redundantly, it needs to be updated only in one place.

11/4. DBMS Software:

A DBMS is an integrated set of software programs that provides all the necessary capabilities for building and maintaining data base files, extracting the information required for making decisions, and formatting the information structured reports.

The ***DBMS*** software usually ***includes a " query language " , " report writers " , " utilities " , and an application program language***

interface (usually called the *data manipulation language* " ***DML*** ") . Each of these will be described in the following part.

Query Language:

Most managers and other users find a query language for data retrieval to be the most valuable aspect of DBMS software . The objective of a query language is to allow managers to easily ask questions of DBMS and obtain information on demand from it for report. For example, take a request for inventory information. A question that the user could ask using a query language when a single file is involved is as: " List all items in the data base for which the quantity on hand is less than or equals to the reorder point”. (This information would be used to process regular requests for restocking inventory) Here is an example of a question that

the user could ask using a query language when more than one file is involved: "List the names and addresses of all customers who ordered items that were out of stock and that are now in stock." (This would involve using both the customer file and the inventory file and would show a listing of all customers who should be notified by mail that the items they ordered are now available for pickup.) You, the user, can learn to use a typical query language effectively with about eight hours of instruction and practice. Once armed with this skill, you can prepare a special report in a few minutes instead of several days or weeks Several powerful query languages , including ***SQL*** (IBM), ***dbase*** ***IV*** (Ashton-Tate), and ***Oracle*** (*Oracle*),exist for use with microcomputers .

Report Writer:

The report writer aspect of ***DBMS*** software for microcomputers simplifies the process of generating reports. For example, if we use the inventory file to generate a report to be handed out that shows the result of the query concerning the inventory items less than reorder point. The procedure is usually fairly easy and involves specifying column headings for the items to be included in the report, as well as any totals, subtotals, or other calculations.

Utilities:

The utilities part of the DBMS software is used to *maintain* the data base on an ongoing basis . This includes tasks such as:

(1)*Creating and maintaining the data dictionary*.

(2) *Establishing control of access to portions of the data base* (Protecting the data base against unauthorized use.)

(3) *Providing an easy way to back up the data base and recover data if the data base is damaged.*

(4) *Monitoring performance*.

(5) *Preventing data corruption when multiple users attempt to access the same data base at the same time.*

Data Manipulation Language (DML):

The user needs the ***DML*** software in the DBMS to affect input to and output from the data base files ; in other words, all programs, including the query language, must go through the DML, which comprises the technical instructions that make up the input / output

**

routine in the DBMS . Each applications program that is written needs certain data elements to process and to produce particular type of information. A list of required elements of data is contained within each applications program. The DML uses this list, identifies the elements of data required, and provides the link necessary to the data base to supply the data to the program.

11/5 Data Base Models:

In a file management system, data is stored in segregated files. This system cannot store information about how data in one file is related to data in another file. A data base, however, can store data relationships, so files can be integrated. Data stored in integrated files can be combined. The way the data base organizes data depends on the type, or "*model* "of the data base. There are

three data base models ***hierarchical, network, and relational***. Each type structures, organizes, and uses data differently. The ***Hierarchical and Network Data Base Models*** have been *used principally on mainframe computers*. The ***Relational Data Base Model*** has been used extensively on *microcomputers* and is also being used more and more on *larger computers for large-scale applications.*

The relational data base model *is made up of many tables, called relations*, in which related data elements are stored. The relations similar in concept to files- are made up of rows and columns, and they provide data to the user about an entity class. A *row (similar to a record)* is called a *tipple*, and a *column (similar to a field)* is called an *attribute*. The data content of a relation or file is determined by the ***relationship*** between

the parts to the whole. *The main objective of the relational model is to allow complex logical relationships between records to be expressed in a simple fashion.* Relational data bases are useful because they can cross reference data and retrieve data automatically. Users do not have to be aware of any "structure" to use a relational data base, and they can use it with little effort or training. Also, data can be easily added, deleted, or modified.

CONTENTS

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